JUL 2 - 93

VOLUME 19 NUMBER 6

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JUNE 1934

PUBLISHED MONTHLY BY AMERICAN MEDICAL ASSOCIATION, 535 NORTH DEARBORN STREET, CHICAGO, ILLINOIS. ANNUAL SUBSCRIPTION, $6.00

Entered as Second-Class Matter, January 14, 1925, at the Postoffice at Chicago, Illinois, Under the Act of March 3, 1879. Acceptance for mailing at special rate provided for in Section 1103, Act of October 3, 1917, authorized January 22, 1925.

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VOLUME 19 JUNE 1934 NUMBER 6

CARCINOMA OF THE LARYNX

AN ANALYSIS OF FIFTY-EIGHT CASES WITH TREATMENT BY LARYNGOFISSURE

LOUIS H. CLERF, M.D.

PHILADELPHIA

If carcinoma of the larynx is suspected, a positive diagnosis, utilizing all of the necessary diagnostic methods, should be made without delay. While the expectancy of life in the average case of untreated cancer is approximately two years, this can be added to only if a diagnosis is made early and adequate treatment is promptly instituted. Surgical treatment, to be effective, must completely remove the growth; this performance is best carried out during the early stages of the disease, a period to be reckoned in months, not years. Successful results in laryngeal cancer therefore depend on early diagnosis and complete surgical extirpation.

It has been the experience of every laryngologist to see patients with hopelessly advanced cancer. A number of these patients failed to consult a physician until the disease was inoperable. Others, receiving treatment for presumptive chronic laryngitis or chronic hoarseness, had no previous examination of the larynx. While it is not always easy to perform mirror laryngoscopy because of anatomic variations, a positive diagnosis of laryngeal neoplasm can be made in every case if all of the necessary diagnostic means are utilized. This should include examination of a representative portion of tissue removed by direct or indirect laryngoscopy. Lack of skill in the practice of indirect or mirror laryngoscopy should not be considered an adequate reason for its nonperformance in every patient complaining of hoarseness. Every physician who seeks to treat patients exhibiting symptoms referable to the larynx should be able to practice mirror laryngoscopy or should have available the services of one competent in this field. In this connection it would be well to direct the attention of those engaged in teaching undergraduate medical students and interns to the importance of imparting a practical knowledge of the more common diagnostic methods. The crowded curriculum of the medical school does not allow sufficient time for the student to become proficient in mirror laryngoscopy. He should, how-

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Revised copy of a paper read at a meeting of the Eastern Section of the American Laryngological, Rhinological and Otological Society, Rochester, N. Y., Jan. 5, 1934.

ever, learn the underlying fundamental principles and the importance of their clinical application. The intern should gain a great part of his clinical experience in the outpatient department. Too often his time is taken up assisting with surgical procedures which constitute a part of postgraduate instruction and not of general internship.

The symptoms and clinical appearances of cancer of the larynx and the common sites of involvement have been fully discussed in medical literature, and additional information is available in standard textbooks. These will therefore not be considered here.

The importance of biopsy is generally admitted. Its influence on metastasis is largely theoretical. Extensive trauma at the time of the direct laryngoscopy or the occurrence of a prolonged interval between the removal of a specimen of tissue and surgical extirpation of the cancer may favor dissemination and should be avoided. A competent pathologist can give a final opinion within twenty-four hours. The patient should be advised previous to the biopsy as to whether or not there is possibility of cancer, that a positive diagnosis is necessary, and that surgical treatment will be required if the diagnosis is corroborated. While waiting for the report of the pathologist, necessary preoperative studies and preparations may be instituted to avoid unnecessary delay. Operation should be proceeded with as soon as a positive diagnosis is established. The pathologist should be familiar with the histologic grading of tumors according to their degrees of malignancy. Dr. Baxter L. Crawford, who studied the tumors in this series, has found it practical to differentiate between the two extremes, that is, the low grade malignant squamous cell carcinoma and the high grade anaplastic type. The grades comprising types 2 and 3 in the Broders method of grading have been designated as an intermediate group.

In determining the type of operation to be employed in a given case, the important criteria are the location and extent of the growth and the degree of malignancy. The location of the growth and its extent are commonly determined by mirror laryngoscopy and palpation of the neck, supplemented in certain instances by direct laryngoscopy and roentgen study of the neck. It must be borne in mind that the extent of the lesion is always greater than is apparent by indirect methods of examination. In surgical extirpation it is believed that a fair margin of safety lies in excising all tissues for about 7.5 mm. beyond the demonstrable edges of the growth. It has been shown histologically by New and Fletcher that the extension of cancer of the larynx beyond its apparent margin varies, and that this bears a definite relationship to the degree of malignancy. In the low grade (grade 1) tumor there is no extension; in the intermediate group (grades 2 and 3) the extension varies from 5 to 5.9 mm.

The anaplastic type (grade 4) usually does not extend farther locally but tends to extend earlier by way of the lymph channels.

In a series of fifty-eight cases of squamous cell carcinoma of the larynx in which I operated prior to three years before the present writing, the growth was removed by thyrotomy or laryngofissure. In the earlier cases the selection of operation and the amount of tissue to be removed were decided on the basis of the location and the extent of the growth. Later, this was supplemented by histologic grading of the tumors.

Ether anesthesia, formerly used by the intratracheal method, has been supplanted by local anesthesia. This is supplemented by the use of morphine sulphate and scopolamine hydrobromide. Avertin anesthesia has not proved satisfactory in my hands. Cocaine is applied to the interior of the larynx if adequate anesthesia cannot be secured by blocking the superior laryngeal nerves. Tracheotomy with packing of the trachea above the tube as soon as the thyroid cartilage is divided is practiced in cases requiring extensive removal of tissue.

The technic of laryngofissure conforms in a general way to that practiced by Chevalier Jackson. The thyroid cartilage is split in the midline with specially devised shears or divided with a saw, depending on the location of the growth and the degree of ossification of the cartilage. Soft tissues supported by cartilage are removed by subperichondrial dissection. One or both vocal cords, a part of, or an entire, arytenoid cartilage and a part of the ventricular band are removed, depending on the extent of the lesion. The corresponding subglottic tissues are commonly removed, and if there is subglottic extension the cricothyroid tissues down to the cricoid cartilage are also excised. Portions of thyroid cartilage are removed when there is accidental separation of the external perichondrium. In cases of involvement of the thyroid cartilage by contiguity, laryngectomy is performed. Extension to the cartilage was observed in one case, and the entire larynx was removed. This case is not included in the present series. Bleeding from the intralaryngeal tissues is controlled by suture ligature. Laryngeal packing has been abandoned.

I have practiced this more or less radical form of laryngofissure because I believed that in certain cases it was as effective as laryngectomy in removing the primary growth. It differs from a simple laryngectomy only in a failure to remove the cartilaginous framework of the larynx. I first employed it during June 1927 in the case of a woman, aged 51, who had an extensive laryngeal lesion involving the entire right vocal cord from its anterior extremity to and including a portion of the inner surface of the corresponding arytenoid cartilage. There was some extension laterally into the ventricle. The diagnosis

of cancer was verified by biopsy, and Dr. Crawford considered it a highly malignant type. Laryngectomy was advised. The patient refused to consider complete removal, but was willing to undergo any form of operation so long as the normal airway was retained. The entire right vocal cord, ventricular band and arytenoid cartilage with the subglottic tissues and cricothyroid structures and the anterior third of the left cord and ventricular band were removed. Feeding by tube was instituted. After two weeks soft foods could be swallowed, but six weeks elapsed before the patient could swallow water. No complications developed, and the patient had had no recurrences six and one-half years after operation. After handling this case I did not hesitate to remove a part of, or an entire, arytenoid cartilage in order to secure a sufficient margin of normal tissue beyond the apparent edge of the growth. Obviously this plan of treatment is inadequate if metastasis has occurred, if the growth has involved the thyroid cartilage or if its proximity to an arytenoid or the cricoid cartilage does not permit removal of sufficient surrounding normal tissue. It also should not be employed in cases of cancer of the epiglottis or of the aryepiglottic fold or in lesions originating in the infraglottic portion of the larynx. If, on the basis of observations made by New and Fletcher regarding the extension of cancer, one can secure an ample margin of normal tissue beyond the growth and if there is no demonstrable metastasis or evidence of extension to the cartilage, I believe that this type of operation is as effective as complete removal of the larynx.

A plan of treatment, irrespective of its speculative merits, can be evaluated only in retrospect on the basis of clinical results. A series of fifty-eight consecutive cases of cancer of the larynx, in which the patients were treated by laryngofissure, have been subjected to analysis from the standpoint of sex, age, death from postoperative complications, death from intercurrent diseases within three years after operation, recurrence of cancer and recovery without recurrence for a period of more than three years after operation.

There were fifty-four male and four female patients. The age groups were as follows:

Years	No. of Cases
20-29	1
30-39	2
40-49	15
50-59	20
60-69	15
70-73	5

OPERATIVE MORTALITY

Five patients died of complications developing after operation. This gives a mortality rate of 8.6 per cent, which is high. Four patients, aged 65, 68, 68 and 70, respectively, died of cardiac and renal complications. One of these had coronary thrombosis. The fifth patient, aged 54, had diabetes mellitus. He died on the eighth day of bronchopneumonia and diabetic coma.

Deaths from intercurrent diseases after operation numbered six. In none of the patients who died was there demonstrable evidence of recurrent cancer. Three died following abdominal operations, two had pneumonia, and one had a fatal heart attack.

There were eight cases of recurrence. On these, seven terminated fatally, irrespective of irradiation or laryngectomy. In the remaining case, laryngectomy was successfully performed, and there has been no evidence of recurrence to date, three years and three months after operation. A critical analysis of these cases is important. In six instances the growth was graded as of intermediate type; in one case it was of a malignancy of low grade, and in the eighth case it was anaplastic. In four of the cases of intermediate type and in the one case of low grade malignancy the growth recurred in the larynx; these may therefore be considered as cases of incomplete removal. It may be assumed that laryngectomy or a more radical form of removal should have been performed in preference to a conservative operation. Three of these patients were operated on by a more conservative type of laryngofissure than is now practiced. In two cases the growth recurred in the ventricular band anteriorly on the same side as the original growth. Removal of the anterior portion of the ventricular band at the first operation as now practiced might have resulted in a complete removal of the carcinoma. In three cases laryngectomy was subsequently performed. One of the patients lived for three years and three months without recurrence, another died following recurrence, and the third died of postoperative complications. In one of the three remaining cases there was recurrence in the space between the base of the epiglottis and the hyoid bone with metastasis to the submaxillary lymph nodes. An extensive secondary removal was attempted, but the growth recurred. The original lesion in this case, although extensive, was limited to a vocal cord. It is problematic whether laryngectomy as the original operation would have removed all of the cancer; I believe, however, that removal of the hyoid bone with the larynx would have effected a cure. The sixth case, on the basis of data secured after operation, was not suitable for a laryngeal operation. The growth, an ulcerated lesion, was confined to the middle third of the left cord. The patient was in excellent physical condition; nothing abnormal was noted about the neck.

From the laryngoscopic appearances, the case was ideal for conservative treatment. At operation, the isthmus of the thyroid gland and both lobes were found to be symmetrically enlarged. No prelaryngeal lymph node was palpable. It was decided to excise the isthmus of the thyroid gland to facilitate operation. The excised tissue was sent to the laboratory as a routine procedure. Dr. B. L. Crawford reported islands of squamous cell carcinoma distributed throughout the gland structure. The cells appeared identical with those observed in the specimen of tissue removed from the larynx. The case terminated fatally. In the seventh case, anaplastic in type, metastasis developed in the deep cervical lymph nodes within one year and eight months after operation. There was no recurrence in the larynx. The nodes were unsuccessfully removed.

An analysis of the cases with recurrence would therefore indicate that in five the growth was incompletely removed, and that a more radical form of operation should have been performed; in the sixth case the recurrence between the hyoid bone and the base of the epiglottis might have been successfully treated by a radical operation if it had been discovered sufficiently early. In the seventh case there was unsuspected extension of the cancer to the thyroid gland, and in the remaining case metastasis had occurred to the deep cervical lymph nodes without recurrence in the larynx.

SUMMARY

A group of fifty-eight patients with carcinoma of the larynx treated by a conservative form of operation is discussed. There were five deaths from postoperative complications; six patients died of intercurrent diseases. In eight there was a recurrence of cancer in the larynx, regional lymph nodes or surrounding structures. Seven of these patients died; in the remaining patient laryngectomy was performed, and there has been no recurrence for over three years. Four patients cannot be traced. Thirty-five patients, all of whom were operated on prior to three years before the present writing, have been traced and are free from recurrence of cancer. Of these, eighteen were operated on over five years before the time of this report.

The tumors in the thirty-five living patients were graded as follows:

Type of Tumor	Cases
Low grade of malignancy (grade 1)	8
Intermediate type (grades 2 and 3)	19
Anaplastic type (grade 4)	8

Of the eighteen patients who were free from recurrence for more than five years, four were classified as having the anaplastic type of tumor.

On the basis of eight cases of recurrence and thirty-five cases in which the patients are living and have been free from recurrence for three or more years, the rate of recurrence is 18.6 per cent. Seven of the patients in whom recurrence occurred, died, the remaining patient being free from cancer for over three years following laryngectomy. The mortality rate was 16.2 per cent.

1530 Locust Street

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TEMPERATURE AFTER MASTOIDECTOMY

A STUDY OF ONE HUNDRED CASES

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Since the earliest times the rise in the temperature of the body which accompanies most diseases has held the interest of physicians. The old conceptions of this pathologic condition have been so revolutionized that an elevation of temperature has become one of the most important and valuable of diagnostic symptoms. The presence of fever is capable of a wide range of interpretation, because a large number of diseases or conditions may produce it. When a satisfactory explanation cannot be given for an existing fever, careful search should be made for the cause. One should not be content until it is found or all diagnostic resources are exhausted.

The ideas on the significance and nature of fever repeatedly changed until the clinical thermometer came into general use about 1870. Carl Wunderlich's famous treatise, written in 1868, on the relation of animal heat to disease is, according to Garrison,[1] the very foundation of modern clinical thermometry. He stated that Wunderlich found fever a disease and left it a symptom.

Little mention is made in the literature of the significance of fever following operation on the mastoid except for its importance as a diagnostic symptom of the complications incident to that period. Harris,[2] in 1902, reported his observations of the temperature after operation on the mastoid in 100 selected, uncomplicated cases. His conclusions give a good idea of the importance of postoperative fever in cases in which there is an uninterrupted convalescence.

MATERIAL AND STUDY

A study has been made of the significance of the changes in temperature during the convalescent period in a series of 100 consecutive mastoidectomies. The cases were followed at the Maine General Hospital

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Presented as a candidate's thesis to the American Laryngological, Rhinological and Otological Society, June 1933.

1. Garrison, Fielding H.: History of Medicine, Philadelphia, W. B. Saunders Company, 1929.

2. Harris, Thomas J.: Temperature after Mastoid Operation: Analysis of 100 Cases, Ann. Otol., Rhin. & Laryng. **11**:286 (May) 1902.

Clinic during my service from 1927 to 1932 or were incident to my practice during that period.

The record of each case was examined for: (1) the immediate effect on the temperature produced by the operation; (2) the variations of the temperature curve after operation in the uncomplicated cases; (3) the duration of the postoperative fever in the uncomplicated cases and the day on which it was highest; (4) the postoperative day of the onset and termination of an unusual fever; (5) the variations of the temperature curve in the complicated cases; (6) the effects produced in the temperature as a result of the treatment instituted in the complicated cases.

The record of each complicated case was investigated for the symptoms, clinical observations and physical findings peculiar to the disease or condition which was interrupting the convalescence.

The material has been arranged for study as follows: (1) the temperature curve in 100 cases during the first twenty-four hours following operation; (2) the temperature curve following operation in the uncomplicated cases; (3) the temperature curve following operation in the cases in which there were preoperative complications; (4) the importance of fever as a diagnostic symptom of the complications which occurred after operation.

TEMPERATURE CURVE DURING FIRST TWENTY-FOUR HOURS FOLLOWING OPERATION

The effect of the operation on the temperature curve during the first twenty-four hours was observed in the entire series. In 61 cases there was a drop in the temperature within six to twelve hours after operation, which was followed by an elevation during the next twelve to twenty-four hours. In 25, the temperature continued to rise for twenty-four hours or more. In 3, it increased for from six to twelve hours, but there was a decrease during the first day. In 5 cases the temperature remained normal after the first six hours, and in 6, a normal temperature at the time of operation continued to be normal during convalescence.

In 69 cases there was a drop in temperature at some time during the first twenty-four hours as a result of the operation on the mastoid. Politzer [3] stated that in most cases a rapid decrease in temperature a short time after operation is one of the favorable effects of opening the mastoid process. There was an elevation in temperature during the same period in 89 cases. According to Kopetzky [4] there is usually a

3. Politzer, Adam: Diseases of the Ear, Philadelphia, Lea Brothers & Company, 1903.

4. Kopetzky, Samuel J.: Otologic Surgery, New York, Paul B. Hoeber, Inc., 1925.

distinct febrile reaction which occurs during the first forty-eight hours following a simple mastoidectomy. From these observations one may expect an elevation in the temperature to follow the usual postoperative drop.

POSTOPERATIVE TEMPERATURE CURVE IN UNCOMPLICATED CASES

Sixty patients had an uninterrupted convalescence and were without preoperative complications. In 53, the fever lasted from one to thirteen days, with an average duration of five days. One patient had a low grade, unexplained fever when discharged from the hospital. Six were afebrile at the time of operation and during the entire convalescent period.

The greatest elevation of temperature occurred in 12 cases during the first twenty-four hours following operation; in 36, on the first postoperative day, and in the remaining 12, from the second to the seventh day.

The highest elevation of temperature in 6 cases ranged from 98 to 99, in 19 from 99 to 100, in 16 from 100 to 101, in 7 from 101 to 102, in 6 from 102 to 103 and in 6 from 103 to 104 F.

It is interesting to note that the temperature was above 103 F. in only 10 per cent of the cases, while it did not exceed 101 F. in more than 80 per cent of them. The fever was not accompanied by other symptoms and had no untoward effect on the patient. Harris,[2] in his analysis of the temperature after mastoid operation, concluded: 1. Postoperative rise in temperature of a moderate amount is customary in mastoiditis. 2. Without other symptoms fever is without significance and should not be a source of anxiety.

TEMPERATURE CURVE FOLLOWING OPERATION IN CASES OF PREOPERATIVE COMPLICATIONS

There were 4 cases in this series in which there were complications of otitic origin before operation. The postoperative temperature curve is of interest only as evidence of the patient's progress during convalescence. Two patients were seen with meningitis, 1 with nephritis and 1 with a gastro-intestinal disturbance.

Meningitis.—CASE 1.—A girl, aged 9 years, had meningitis complicating otitis media and mastoiditis. Pus had been draining profusely from the right ear for two months, and the patient had complained of headaches in the right frontal and parietal region for two weeks. She was lethargic, and there was projectile vomiting. There was rigidity of the neck, and Kernig's sign was present. On admission the temperature was 106 F., and the cerebrospinal fluid was cloudy and under pressure. A mastoidectomy was done at once, and was followed by administration of 1,000 cc. of a 5 per cent solution of dextrose intravenously. The condition during the operation and immediately following seemed hopeless, but at the end of twelve hours the temperature had dropped to 105 F., and the

child appeared to be slightly improved. During the next twelve hours the temperature went up rapidly to 108.2 F. (rectal). From this time there began a gradual, steady decline in the temperature, with an improvement in the general condition. On the eighth day after operation, the temperature was normal and recovery continued without further interruption.

Spinal puncture was done every twelve to eighteen hours for the first three days following operation, and three transfusions of whole blood were given. Examination revealed no organisms in the spinal fluid.

CASE 2.—A boy, aged 10 years, had meningitis five days after pus began to drain from the left ear. There was rigidity of the neck; Kernig's sign was present, and the cerebrospinal fluid was cloudy and under pressure. The child was in a coma when admitted to the hospital, and an operation was performed at once on the mastoid process. The highest temperature before operation was 105 F., and for three days following operation it ranged from 103.2 to 104 F. A transfusion of whole blood was given, and a spinal puncture was done every twelve hours. During these three days the patient seemed to be improving as a result of the treatment. On the fourth day his condition rapidly became worse, with an elevation of temperature to 105 F. The child died the same day. The laboratory reported the hemolytic streptococcus present in the spinal fluid. An autopsy was not permitted.

Nephritis.—CASE 3.—A boy, aged 4 years, had bilateral otitis media and mastoiditis of six months' duration, which had been complicated for three months by nephritis. He was admitted to the hospital, and both mastoid processes were operated on as soon as his condition would permit. Before operation the temperature ranged from 99 to 100 F., and for two weeks after it varied from 99.6 to 103.5 F. Two transfusions of whole blood were given during the first week as supportive treatment. The child was discharged at the end of four weeks much improved, but the temperature did not become normal during hospitalization.

Gastro-Intestinal Disturbance.—CASE 4.—A boy, 9 months old, had a gastro-intestinal disturbance accompanying otitis media. The temperature was 101 F. on admission, and a myringotomy was done at once. For three days following drainage of the middle ear, no improvement was seen, and the temperature varied from 99 to 103.5 F. On the fourth day a mastoidectomy was done, and in forty-eight hours the temperature had dropped to 100 F. The middle ear and mastoid did well following the operation, but every few days there would be a sudden rise in temperature from 100 to 101.5 F., accompanied by an exacerbation of the gastro-intestinal symptoms. It seemed evident in this case that the gastro-intestinal infection was the cause of most of the fever during convalescence.

FEVER AS A DIAGNOSTIC SYMPTOM AFTER OPERATION

Coates, Ersner and Persky [5] believed that the temperature curve is far more important, diagnostically, in the convalescent period, especially in the first few days after operation, than in the preoperative period. They stated that, unquestionably, it is one of the most definite indications of any complication that might arise.

A sudden elevation of temperature, with or without rigor or chilliness, occurring after a mastoid operation should be regarded with

5. Coates, G. M.; Ersner, M. S., and Persky, A. H.: Study of Mastoiditis: A Résumé of 644 Cases, Laryngoscope **40**:245 (April) 1930.

suspicion. If the fever is caused by an extension of the infection from the temporal bone to the lateral sinus it is important that a diagnosis be made before metastasis takes place. The surgeon should not conclude that an infection exists in a sinus until he has made a thoughtful differential diagnosis. He will endanger the condition of his patients less by taking time for careful observation and diagnosis than by making too hasty conclusions which may result in subjecting them to the hazards of misdirected surgical intervention.

The complications which appeared in 36 cases following operation were discovered, and measures were taken which prevented serious accident, except in 1 patient who died of septicemia on the fifth postoperative day. The complications incident to convalescence were as follows: otitis media and mastoiditis in the opposite ear, 10 cases; involvement of the mastoid wound, 7; cervical adenitis, 7; infection of the respiratory tract, 4; infection of the lateral sinus, 3; involvement of the kidneys, 2; measles, 1; pelvic abscess, 1, and septicemia, 1.

Otitis Media and Mastoiditis in the Opposite Ear.—The most common cause for interruption of the convalescent period was otitis media and mastoiditis in the opposite ear. There were 19 patients who had a bilateral mastoidectomy. In 10 instances both mastoids were operated on at the same time.

It was necessary later to operate on the other ear in the 4 cases in which there had been a discharge from both ears at the time of the first operation. Three of these patients had fever following the first mastoidectomy and 1 was afebrile. Two of the febrile patients had a slight drop in temperature after the first twenty-four hours, but from this time the fever persisted until the other ear was operated on. The other patient had a normal temperature in three days and continued afebrile until the thirteenth day, when the temperature rose suddenly to 101 F.

In these cases the temperature curve was of little importance as a deciding factor for operation on the opposite ear. Kerrison's [6] experience in the majority of cases of mastoiditis is that fever is absent or is so slight as to be of no special diagnostic value.

There were 6 cases in which, following a mastoidectomy, otitis media appeared in the other ear. The first symptom noted was a sudden elevation of temperature, ranging from 100 to 104.5 F. The fever appeared on the fourth to the twelfth day after operation. Myringotomy was done in 5 cases, and in 1 spontaneous rupture of the membrana tympani occurred. A temporary drop in temperature was noted in

6. Kerrison, Philip D.: Diseases of the Ear, Philadelphia, J. B. Lippincott Company, 1923.

every case following drainage of the middle ear. It was necessary to operate on the mastoid in all of them with the exception of 1.

When an unexplained fever occurs after an operation on the mastoid, an examination of the opposite ear should immediately be made for a possible cause.

Involvement of the Mastoid Wound.—A local infection involving the mastoid wound may develop at any time after operation, but it usually occurs during the first three or four days. The most common types of infection are stitch abscess, cellulitis and erysipelas.

The occurrence of an infection in the wound, except erysipelas, sufficient to cause an elevation of temperature is relatively uncommon. Four cases were noted in which fever could not be explained in any other way. There were 3 patients with cellulitis of the wound and 1 with a stitch abscess. The temperature went up gradually beginning from the third to the sixth day. It lasted from three to seven days, varying from 99.6 to 102 F., with the lowest occurring in the patient having the stitch abscess. The diagnosis of the cause of the fever presented no special problem, and convalescence was not prolonged except in 1 patient with cellulitis of the wound complicating hemorrhagic mastoiditis.

Erysipelas as a postoperative complication may be perplexing, since the cause of the fever remains in doubt until the inflammation shows on the surface. It is sometimes difficult to differentiate the condition from sinus thrombosis before the appearance of the rash. The chief points to be kept in mind in making a differential diagnosis are: 1. The infection from erysipelas usually appears in a short time after operation, while in sinus thrombosis, it ordinarily does not show within the first week. 2. The temperature in erysipelas tends to be high or remittent, while in sinus thrombosis, it is intermittent. 3. The patient is more prostrated and appears to be very ill with erysipelas as compared with the sense of well-being during a remission in sinus infection.

In a series of 174 mastoidectomies, Dixon [7] had 4 cases of erysipelas complicating operation on the mastoid and stated that too early surgical intervention is the real etiologic factor.

There were 3 cases in this group in which postoperative erysipelas developed. The operation on the mastoid was done on the fourth, eleventh and fourteenth day, respectively, after the beginning of the aural discharge. These observations are not entirely in accord with those made by Dixon regarding the etiology of erysipelas. In these cases of erysipelas the rise in temperature, accompanied by a chill or chilliness, appeared suddenly on the third to the thirteenth day. One

7. Dixon, O. J.: Erysipelas as a Complication of Early Surgical Interference in Mastoiditis, J. Missouri M. A. **27**:530 (Nov.) 1930.

patient had nausea and vomiting. In 2 cases the fever lasted from three to four days, with a daily variation from 101 to 104.5 F.; in the other it continued intermittently for twenty-one days, varying daily from 101 to 106 F. during the acute phases.

The inflammation appeared on the surface in from twenty-four to forty-eight hours after the beginning of fever. In 1 case it was noticed first on the lobe of the ear, and later it extended into the cheek. In 2 it was first seen on the cheek, and the ear was not involved during the entire course. In 2 cases the inflammation was confined to one side of the head and faded out in a few days. In the other case, in a child 11 years old, with severe diabetes, it appeared on the cheek and spread in fresh outbreaks to include both sides of the face, scalp and neck and one shoulder. These exacerbations, accompanied by a septic temperature, continued for three weeks, then suddenly ceased, and the temperature became normal.

Cervical Adenitis.—The etiology of cervical adenitis in children with mastoiditis may be obscure. It is difficult in the presence of suppurating otitis media and mastoiditis to determine whether the adenitis is from this infection or from an infection of the upper respiratory tract which subsided before the inflamed glands were discovered. Clemens [8] found adenitis of the cervical and posterior auricular glands a frequent complication of acute otitis media. In a series of 109 cases of cervical adenitis which Holt [9] mentioned, suppurative otitis media was present in 16 per cent.

The patient may not have complaints which would lead the physician to suspect cervical adenitis as a cause for the unexplained fever. The sudden appearance of a septic temperature is often the only symptom. An inspection of the neck for glandular enlargement or tenderness should be made daily until the cause of the fever can be found. A diagnosis of cervical adenitis cannot be made until the enlarged glands appear and until after other causes are excluded.

Six cases were observed in children between the ages of 4 months and 14 years. The fever appeared suddenly on the third to the twenty-first day after operation, an average of nine days, reached its height in three or four days and then began to fall by lysis. In 3 cases there were several exacerbations of a sudden fever which lasted a few days and receded. In 2 cases an infection of the upper respiratory tract was noted as a probable cause of the adenitis. Three patients complained of stiffness and soreness in the neck. The lowest daily temperature varied from 98 to 99.5 F., while the highest ranged from 101.5 to

8. Clemens, James B.: Complications of Acute Middle Ear Suppuration, Ann. Otol., Rhin. & Laryng. **12**:97 (March) 1903.

9. Holt, L. Emmett: Diseases of Infancy and Childhood, New York, D. Appleton and Company, 1920.

104.6 F. The enlarged glands were discovered two or three days after the beginning of the fever, and the acute phase lasted from five to sixteen days.

CASE 5.—A man, 59 years old, with diabetes had a sluggish wound, that healed slowly, and on the forty-fourth day after operation a hard glandular swelling was found in the neck below the tip of the mastoid process. Two weeks later a cervical abscess containing a large amount of thick pus was opened and drained. There was no elevation of temperature during this period.

Infections of the Respiratory Tract.—An infection of the respiratory tract developed during convalescence in 4 patients. Three had bronchitis which occurred from the second to the twelfth day, and 1 had acute follicular tonsillitis on the seventh postoperative day. The temperature went up gradually, and the febrile period lasted from four to ten days. The daily temperature ranged from 100 to 102 F. in the patients having bronchitis; it fell by crisis in 1 instance. The highest temperature in tonsillitis was 100.4 F. The diagnosis was made early, and the period of hospitalization was not lengthened by the infection.

Infection of the Lateral Sinus.—Infection of the lateral sinus as a complication of otitis media and mastoiditis has held the attention of writers for some time, and a great deal has been written on its etiology and symptoms and on the methods of treatment. With the first appearance of a septic temperature the otologist naturally thinks of an extension of the infection from the mastoid process to the lateral sinus. A differential diagnosis is begun at once to determine if this is the cause of the fever. When a positive diagnosis is established, surgical intervention is indicated without delay.

According to Campbell,[10] most authors agree that lateral sinus thrombosis occurs in from 3 to 6 per cent of the operative cases in mastoiditis. An infection of the lateral sinus developed from eight to twelve days after operation in 3 patients in my series. The first symptom noted was a sudden elevation of temperature in the afternoon, which was accompanied by a chill in 2 patients. The next morning the temperature had receded, and the patients felt well. The afternoon rise continued until an operation was performed on the lateral sinus. Before operation the temperature in the morning varied from 98.6 to 100 F. and in the afternoon, from 104 to 105.8 F.

Repeated blood cultures taken at the height of the fever were reported negative. The diagnosis was made on clinical findings and by ruling out other infections as the possible cause for the fever. The condition of 1 patient with follicular tonsillitis and an exacerbation of an old pyelitis was in doubt for six days.

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10. Campbell, Edward H.: Complications of Otitis Media and Mastoiditis, Ann. Otol., Rhin. & Laryng. **38**:209 (March) 1929.

In 2 of the cases a wide exposure was made of the sigmoid portion of the lateral sinus by removal of the diseased bone in contact with it, in one case on the second, and in the other on the third, day after the beginning of the fever. A transfusion of whole blood was given at the time of operation. The temperature was lower in both cases on the following day. In one, it became normal on the third day and remained so during convalescence; in the other, it rose to 104 F. on the second day; the sinus was then ablated, and the jugular vein sectioned. The next day the temperature was normal and did not go up again. The diagnosis was not made in the third case until late, and conservative measures did not seem advisable as there was evidence of a thrombus. The sinus was ablated and the jugular vein sectioned; a transfusion of whole blood was given at the time of operation. The temperature was normal after the second day, and convalescence was uneventful.

Lillie [11] stated that in certain cases early involvement of the blood stream from otitis media and disease of the mastoid can be treated satisfactorily by removal of the diseased process without interference with the sigmoid sinus or jugular vein. When the condition of the patient is such that radical procedure does not seem necessary, the more conservative method as advocated by Lillie is followed.

Involvement of the Kidneys.—One should be aware that involvement of the kidneys may be a complication of otitis media, and a complete urinalysis is indicated with the first appearance of an unusual fever. The occurrence of pyelitis, especially in females, is not uncommon, and it should be carefully ruled out as a possible cause of a septic temperature. It may be necessary to have a urinalysis at frequent intervals, as pus is not present at all times in pyelitis.

There were 2 cases in which an infection of the kidneys developed following operation, with a sudden elevation of temperature as the only symptom.

CASE 6.—A girl, aged 3 years, was making good progress after a mastoidectomy until the sixth postoperative day, when the temperature rose to 102.5 F. The fever continued for ten days, the greatest daily variations being from 98 to 104.5 F. Urinalysis revealed acute nephritis; on the third day of the high fever she had edema of the face which lasted a week. The temperature dropped quickly to normal and remained so most of the time the child was in the hospital.

CASE 7.—A girl, 7 years of age, had otitis media and mastoiditis complicating measles. On the afternoon of the fourth postoperative day the temperature rose to 103 F. without chill or other symptoms, and the next morning it was normal.

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11. Lillie, H. I.: Otitis Media and Diseases of the Mastoid, J. A. M. A. **94**: 531 (Feb. 22) 1930.

Urinalysis on the second day revealed pyelitis, which was not evident on the previous day. The temperature varied from 98 to 103 F. for four days and then gradually became normal.

Measles.—Case 8.—Measles appeared in a girl, 8 years old, on the sixth day after operation. The first symptom noted was a gradual elevation of temperature which did not seem consistent with the infection present in the upper respiratory tract. The cause of the fever was uncertain until Koplik's spots were discovered. The daily temperature varied from 101 to 104 F. for ten days and then was normal for a week. From this time until the child was taken from the hospital there were febrile periods lasting three or four days, the temperature varying from 98 to 102 F. during the exacerbations.

Drainage from the middle ear and mastoid became more profuse with the appearance of measles and had not cleared up when she was taken from the hospital. The only explanation for the prolonged fever was the patient's poor general condition and the persisting infection in the middle ear and mastoid process.

Pelvic Abscess.—The rather unusual coincidence of a pelvic abscess interrupted convalescence of 1 patient, and the diagnosis was in doubt for several days.

Case 9.—During a mastoidectomy on a woman, 32 years old, the lateral sinus was accidentally ruptured. Bleeding was controlled without difficulty, and the operation was completed. She was making an uneventful recovery until the afternoon of the tenth day, when the temperature rose to 103.4 F. without other symptoms. The following morning the temperature was normal, but in the afternoon it went up again; it continued this course for four days, the daily temperature ranging from 99.5 to 104.5 F. The appearance of the mastoid wound, a physical examination and complete urinalysis did not reveal the cause of the fever. Blood cultures taken at the height of the fever were reported negative, but most of the clinical evidence seemed to point to an infection in the blood stream. The general appearance of the patient, however, did not seem consistent with an involvement of the blood stream. It was decided to wait for a time, as her condition was not getting worse. On the fourth day after the beginning of the septic temperature, she complained of pain in the lower part of the abdomen and was examined by a gynecologist. A pelvic inflammation was found, and an abscess was drained a few weeks later.

Septicemia.—Case 10.—A man, 57 years old, was doing well following a myringotomy until the thirteenth day when the temperature rose to 103 F., and he appeared to be drowsy. The next morning a mastoidectomy was done. A coalescent type of mastoiditis was found, with necrosis and breaking down of the cell structures. The wall of the sigmoid portion of the lateral sinus was exposed and found to be normal in appearance. At 4 p. m. on the day of operation the temperature was normal. From this time there was a steady rise to 105 F. within thirty-six hours. Eight hours later, the temperature had dropped to 102 F. During the next four hours it returned to 105 F., following a chill. The next morning the temperature had receded to 100.5 F., and the highest value for that day was 102 F. The variation on the fourth postoperative day was from 100.5 to 102.5 F. About 4 a. m. on the fifth day the patient complained of feeling weak and tired, and the temperature began to fall rapidly. He died at 7:30 a. m.; 96 F., the last recorded temperature, was taken one hour before death.

The differential diagnosis for this patient was perplexing. His only complaints were a sensation of fulness in the epigastrium and a pain in the right leg, in the

region of the knee, when he moved it about in bed. He had a slightly disturbing cough and vomited only after taking food. Physical examination revealed a medium amount of swelling in the right leg, extending from the lower third of the thigh to the ankle. There was some abdominal distention, and the mucous membrane in the upper respiratory tract was congested. Blood cultures taken at the height of the fever were reported negative, and the white cell count was 22,500. The urine was normal except for rare white blood cells. The drowsiness, which was noted before operation, was clearing up on the second postoperative day, but the patient had the appearance of a very sick man after the first twenty-four hours following the operation. A diagnosis of an involvement of the lateral sinus was not made before the patient died, and the cause of the systemic invasion was not found. Postmortem examination revealed evidence of general infection in the phlebitis of the right leg and of sepsis in the enlarged spleen. There was no thrombus in the lateral sinus.

IRREGULARITIES IN THE CASE RECORDS

There were deficiencies in the records of certain cases which made their interpretation difficult: 1. It was not always specified where the temperature was taken. 2. The intern's progress notes were not complete in all of the clinical cases. 3. In some of the clinical cases no history of the patient before his admission to the hospital was obtained. 4. The laboratory reports were incomplete or missing in several instances.

SUMMARY AND CONCLUSION

1. Within from six to twelve hours after operation 66 per cent of the cases in this series showed a decrease in temperature, while 28 per cent showed an elevation.

2. Within from twelve to twenty-four hours after operation 86 per cent of the cases showed an elevation in temperature while 8 per cent showed a decrease.

3. In 6 cases the temperature was normal before operation and during convalescence.

4. Sixty per cent of the cases were without complications; in 4 per cent there were complications of otitic origin before mastiodectomy, and in 36 per cent complications developed after operation.

5. The febrile period averaged five days in the uncomplicated cases, in 80 per cent of which the greatest elevation of temperature occurred during the first twenty-four hours after operation.

6. The postoperative temperature in cases of preoperative complications was of no special diagnostic interest.

7. In the 36 cases in which complications developed after operation, these were of a serious nature in 4.

8. An elevation of the temperature curve was the first warning of an existing complication in more than 86 per cent of the cases.

9. Two deaths occurred.

LABYRINTHITIS AND SINUS THROMBOSIS COMPLICATING SUPPURATION OF THE MIDDLE EAR

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The combination of labyrinthitis and sinus thrombosis complicating suppurations of the middle ear occurs more frequently than is commonly believed. Of the seven cases of suppurative labyrinthitis which I have studied histologically, two presented this combination. The labyrinthitis and the sinus thrombosis may be independent of one another, each being caused by the original infection of the middle ear extending along different routes. When one is the direct cause of the other, thrombosis of the sigmoid sinus is usually secondary to the labyrinthitis. However, at times the reverse is true.

PATHWAYS OF INFECTION

Infection of the labyrinth may spread to the sigmoid sinus along preformed as well as along newly formed pathways. The saccus endolymphaticus and the labyrinthine veins are the most common of the preformed routes. The newly formed pathways consist of fistulas from within the labyrinth through the semicircular canals or through the body of the labyrinth.

Preformed Pathways.—Saccus Endolymphaticus: The saccus endolymphaticus is a narrow pouch between the layers of the dura which communicates with the endolymph space of the labyrinth through the ductus endolymphaticus. It is situated on the posterior surface of the petrous pyramid, midway between the medial border of the sigmoid sinus and the internal auditory meatus. An infection in the saccus may spread between the layers of the dura and produce a cerebellar abscess; it may involve adjacent bone and produce a huge extradural abscess; it may involve the pia-arachnoid and cause meningitis, or, finally, it may extend along the dura to the sinus and cause sinus phlebitis or thrombosis. I am particularly interested in the last mentioned route. Cases illustrating the various methods of extension have been described by Haymann,[1] Horne[2] and Zange.[3] In a report of

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From the otologic service of Dr. Friesner and the Department of Laboratories, Mount Sinai Hospital.

1. Haymann, L., in Denker, A., and Kahler, O.: Handbuch der Hals- Nasen- u. Ohrenheilkunde, Berlin, Julius Springer, vol. 3, p. 96.

2. Horne, Jobson: Formation of a Circumscribed Intradural Abscess at Site of Saccus Endolymphaticus, J. Laryng., Rhin. & Otol. **15**:293, 1900.

3. Zange, Johannes, in Kerner, Otto: Die Ohrenheilkunde der Gegenwart und ihre Grenzegebiete, Munich, J. F. Bergmann, 1919, p. 250.

eighteen cases of empyema of the saccus, Zange found that nine terminated in cerebellar abscess, five in extradural abscess of the posterior surface of the petrous pyramid, three in sinus thrombosis and one in leptomeningitis.

Labyrinthine Veins: An infection of the labyrinth may reach the sigmoid sinus through the labyrinthine veins which empty into the inferior petrosal sinus or the jugular bulb. From these structures the infection may spread laterally to the sigmoid sinus or medially to the cavernous sinus. Kleinfeld [4] recently reported a case of otitic sepsis following a suppurative labyrinthitis. He attributed the sepsis to the involvement of the inferior petrosal sinus and jugular bulb via the labyrinthine veins. Braun [5] also recorded a case of suppurative labyrinthitis complicated by cavernous sinus thrombosis through the intermediary involvement of the inferior petrosal vein.

Newly Formed Pathways.—These consist of: (1) fistulas of the semicircular canals and (2) fistulas of the body of the labyrinth. Infection from the labyrinth may extend to the sigmoid sinus or jugular bulb by direct contiguity through necrosis of the bone. Hence the infection must break through one or more of the semicircular canals (usually the posterior) or through the body of the labyrinthine capsule (Lange [6]). In other words, a fistula from within outward is produced, in contradistinction to the usual fistulous formation from without inward. Fistulas from within outward are rare. Cases of multiple fistulas of the semicircular canals have been described by Jansen [7] and others. Zange,[3] who in 1919 reviewed the literature, could find only six proved cases. In each of these the fistulas from the labyrinth resulted in intracranial complications. In only one case, that described by Hegener,[8] was the sinus involved. The infection spread downward from the labyrinth toward the bulb, causing a peribulbar abscess and phlebitis of the jugular vein. The intima, however, was not involved, so that actual thrombosis did not take place. This method of extension is by direct contiguity of necrosis of the bone in contradistinction to extension

4. Kleinfeld, L.: Recovery After Streptococcus Meningitis Following Otitic Sepsis, Laryngoscope **44**:56 (Jan.) 1934.

5. Braun, Alfred: A Case of Cavernous Sinus Thrombosis Complicating Suppurative Labyrinthitis, Ann. Otol., Rhin. & Laryng. **23**:368, 1914.

6. Lange: Beiträge zur pathologischen Anatomie der vom Mittelohr ausgehenden Labyrinthentzündungen, Beitr. z. Anat., Physiol., Path. u. Therap. d. Ohres **1**:1, 1908.

7. Jansen, A.: Zur Kenntnis der durch Labyrintheiterung inducierten tiefen extraduralen Abscesse in der hinteren Schädelgrube, Arch. f. Ohrenh. **35**:290, 1893.

8. Hegener, J.: Labyrinthitis und Hirn Abscess, Beitr. z. Anat., Physiol., Path. u. Therap. d. Ohres **2**:359, 1909.

along the preformed pathway, i. e., the labyrinthine veins. In the same way an infection may spread from the labyrinth through the adjacent bony structure of the petrous pyramid to involve the superior petrosal sinus.

CONSIDERATIONS IN DIAGNOSIS AND TREATMENT

One must be guarded in diagnosing an intracranial complication secondary to suppurations of the labyrinth. While the usual signs and symptoms of such complications as petrositis, deep extradural abscess or sinus thrombosis secondary to or associated with labyrinthitis may be present, they are frequently absent. Thus sinus thrombosis was suspected in neither of the two cases reported. Even in the presence of definite labyrinthine disease one must rule out the more common associated infectious pathways from the middle ear to the petrous pyramid and meninges in the production of an intracranial complication. The diagnosis is often made only at postmortem examination. But even with the aid of histologic examination it is at times difficult to establish a direct causal relationship between the labyrinthitis and the sinus thrombosis.

It is beyond the scope of this article to include the indications for or against operative intervention in cases of labyrinthitis. However, it is reasonable to assume that in some cases the development of intracranial complication secondary to labyrinthine disease may be forestalled by the proper therapy. On the other hand, it follows that if this intracranial complication is not secondary to the labyrinthitis but merely associated with it, it cannot be checked by any therapeutic measures designed to alleviate the labyrinthine disease. This is undoubtedly a factor in the high mortality rate in suppurative labyrinthitis, particularly in the acute cases.

REPORT OF CASES

CASE 1.—J. S., a man, aged 32, was admitted to the otologic service of Dr. Friesner on Oct. 3, 1929, with a history of pain in the left ear of seven days' duration associated with a spontaneous profuse discharge for five days. For the past two days he had had frontal headaches and a temperature of 102 F. These symptoms continued up to the time of admission.

Eight months prior to admission the patient was treated at the Mount Sinai Hospital for acute lobar pneumonia; at that time it was noted that the Wassermann reaction of the blood was 4 plus.

Physical Examination.—The patient appeared acutely ill. There was a swelling over the left mastoid extending upward and forward to the zygoma which pitted on pressure. There was a profuse thick purulent discharge from a tubal perforation which reappeared rapidly. Definite sagging of the posterior superior canal wall was present. The hearing was markedly impaired. The right ear was normal.

The diagnosis was acute operative mastoiditis, and a simple mastoidectomy was performed. At operation considerable edema of the soft parts was noted, but there

was no evidence of cortical perforation. Although no frank pus was found in the mastoid cavity, the bone had a peculiar reddish necrotic appearance. It was soft and easily removable. There was some softening of the sinus plate. This was removed. The uncovered sinus wall appeared normal.

The bone removed at operation was cultured. No growth was obtained aerobically, but on anaerobic growth Streptococcus viridans was obtained.

Postoperative Course.—Two days after the operation the patient complained of dizziness and was nauseated but did not vomit. A nystagmus directed to the right was noted. Tests with tuning forks showed a lateralization to the right. The hearing in the left ear (tested by noise apparatus) was markedly diminished. No meningeal signs were present. A diagnosis of serous labyrinthitis was made. The labyrinthine signs and symptoms continued for about two days postoperatively. Repeated tests of the hearing with a noise apparatus at times gave the impression that hearing was absent, at other times that it was present but markedly impaired. After the usual postoperative rise the temperature never rose above 100 F. The patient was discharged from the hospital much improved three weeks after the operation.

He was readmitted two and one-half months later. With the exception of occasional tinnitus and impaired hearing, he had been well up to two weeks previously, when he began to complain of frontal headaches. The headaches continued with increasing severity. During this time he experienced pain in the teeth and gums. For the relief of this a tooth was extracted. The night before admission he had a shaking chill and fell unconscious. He vomited on several occasions and had convulsive seizures.

Examination.—The patient appeared disoriented and was aphasic. Bilateral ophthalmoplegia, a slight left facial paralysis, bilateral Kernig signs and increased deep reflexes with diminished superficial reflexes were present. There was a slight discharge from the postauricular wound. Examination of the fundi showed an optic neuritis with early swelling.

On lumbar puncture thick, yellowish, purulent fluid under increased pressure was obtained. The cell count was 350,000 per cubic centimeter, with 90 per cent polymorphonuclear leukocytes. A smear showed gram-positive encapsulated diplococci. A culture yielded type III pneumococci. A blood culture also revealed the same type of pneumococcus, 45 colonies per cubic centimeter.

Diagnosis.—A diagnosis of bacterial meningitis from rupture of a localized collection of pus was made.

The patient died on the day of admission.

Necropsy.—A diffuse purulent exudate covered the entire surface of the brain; it was most marked over the base. Sectioning of the brain failed to reveal the formation of an abscess.

Diagnosis: Subacute purulent meningitis.

Gross Appearance of the Temporal Bone: There was a large localized area of bulging dura on the posterior aspect of the petrous pyramid just lateral to and below the internal auditory meatus (fig. 1). This bulging area measured about 1 cm. anteroposteriorly and was about 2 cm. high. Over the swelling the dura was markedly thickened but intact. The swelling pitted on pressure and gave one the impression of containing fluid. No pus could be expressed from the swelling into the intracranial cavity or into the internal auditory meatus. An organized thrombosis was present in the sigmoid sinus.

Microscopic Examination of the Temporal Bone: A marked inflammatory process in the subacute stage was present in the tympanic cavity and in the eustachian tube. The antrum was partially filled with granulation tissue which

Fig. 1.—Posterior aspect of the petrous pyramid showing a large extradural abscess (*A*) in the region of the internal auditory meatus. *IAM* indicates the internal auditory meatus with the eighth nerve; *VN*, the trigeminal nerve.

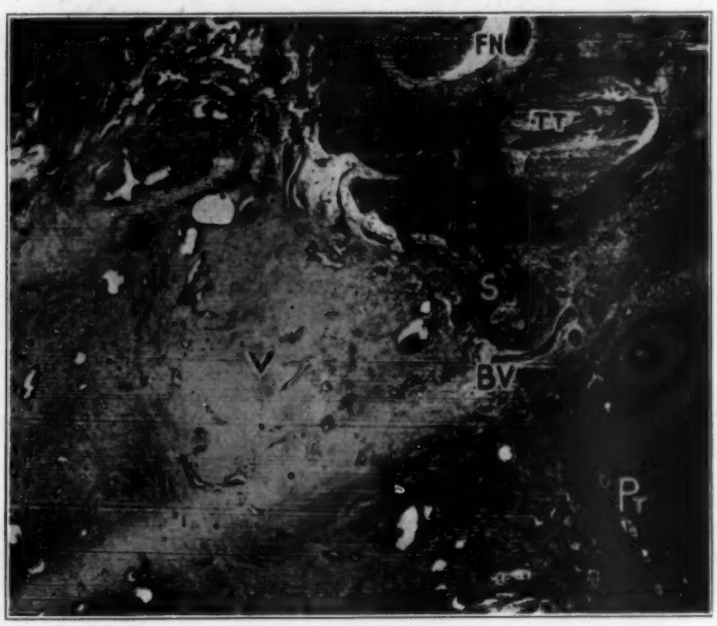

Fig. 2.—Photomicrograph of a vertical section through the vestibule (*V*) showing the presence of granulation tissue and newly formed bone within this cavity. The inflammatory process has extended from the tympanum to the vestibule through the lower part of the annular ligament of the foot plate of the stapes (*S*). An inflamed blood vessel (*BV*) connects these two cavities. *FN* indicates the facial nerve; *Pr*, the promontory; *TT*, the tensor tympani muscle.

had undergone fibrosis. This inflamed tissue was in contact with the dura of the middle fossa. The dura was considerably thickened and infiltrated with cellular elements. The granulation tissue of the tympanum extended into the vestibule through the disrupted annular ligament of the stapedial joint (fig. 2). The fallopian aqueduct was eroded. Nearly the entire labyrinth was filled with scar tissue and was partially replaced by new bone, so that the individual membranous parts could not be discerned (figs. 3 and 4). The labyrinthine capsule was necrotic to the extent that it was almost entirely sequestered. Fistulas of the external and posterior semicircular canal (fig. 4) and of the body of the labyrinthine capsule and necrosis of the perilabyrinthine cells were present.

Fig. 3.—Photomicrograph of a vertical section through the cochlea showing its membranous part entirely replaced by granulation tissue and newly formed bone. The normal anatomic markings can no longer be recognized. A large extradural abscess on the posterior inferior aspect can be seen at *A*. It extends upward to the region of the internal auditory meatus. *C* indicates the cochlea; *CA*, the carotid artery; *D*, the markedly inflamed dura of the posterior fossa; *ET*, the eustachian tube; *IAM*, the internal auditory meatus with the eighth nerve within; *TT*, the tensor tympanic muscle.

A large extradural abscess was seen just lateral to and below the internal auditory meatus (fig. 3). The adjacent bone was necrotic and partially sequestered. The abscess extended above to the region of the internal auditory meatus and below to the jugular bulb. The jugular bulb was almost completely filled with a recanalized thrombus (fig. 5). Organized thrombi were also present in the

sigmoid sinus (fig. 6) and in the superior petrosal vein (fig. 7). The aqueductus vestibuli was eroded and partially replaced by granulations and new bone. A frank empyema of the saccus endolymphaticus could not be discerned.

Comment.—This case presents unusual clinical and pathologic features. An attempt will be made to correlate these features. In the first place, although the patient showed clinical signs of mastoiditis and of a possible subperiosteal abscess, at operation, in spite of a careful search, there was no evidence of cortical perforation or of frank pus in the mastoid cells. The bone, however, had a peculiar necrotic appear-

Fig. 4.—Photomicrograph of a vertical section through the tympanum showing inflammatory changes within this cavity and within the labyrinth. A large fistula of the external semicircular canal is present at *F*. *Ad* is the aditus ad antrum; *EAC*, the external auditory canal; *ESC*, the external semicircular canal; *FN*, the facial nerve; *I*, the incus, and *StM*, the stapedius muscle.

ance. Secondly, after the operation signs of a labyrinthine involvement developed from which the patient apparently recovered in three weeks. He was relatively well for two months when frontal headaches developed. Frank signs of meningitis then appeared. Histologic study clearly demonstrated that the avenue of infection to the labyrinth was through the annular ligament of the foot plate of the stapes. This infectious process in the labyrinth undoubtedly began at the onset of the clinical

signs two days postoperatively. The suppurative labyrinthitis showed advanced stages of healing. The headaches which appeared seven weeks after the operation were a clinical manifestation of meningeal irritation. This was due to the presence of a deep-seated extradural abscess. It is difficult to state definitely whether the extradural abscess was secondary to the labyrinthitis or to the coexisting petrositis. The labyrinth communicated with the dura by multiple fistulous tracts of the external and posterior semicircular canals and of the body of the bony labyrinth, through the intermediary perilabyrinthine cells.

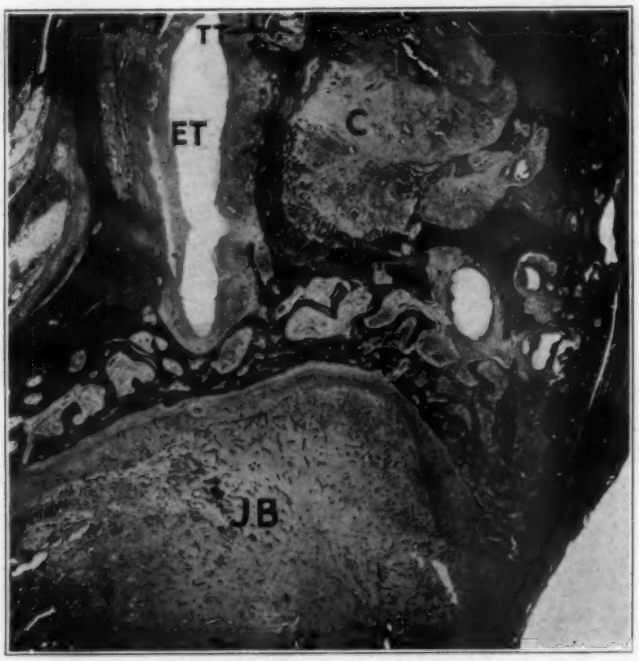

Fig. 5.—Photomicrograph of a vertical section through the eustachian tube (*ET*) showing the jugular bulb (*JB*) completely replaced by an organized thrombus. The changes described for the cochlea (*C*) can also be seen. *TT* indicates the tensor tympani muscle.

Although there were no signs of a sinus thrombosis, the sinus was undoubtedly involved some time previous to his second admission. Histologically there were definite organization and recanalization of the thrombus. These changes gave evidence of a healing process. The thrombosis had extended to the jugular bulb and to the superior petrosal vein. Again, the exact modus operandi of this thrombus formation cannot be definitely stated. At operation the exposed sinus appeared perfectly normal. It is fully appreciated that the macroscopic appearance

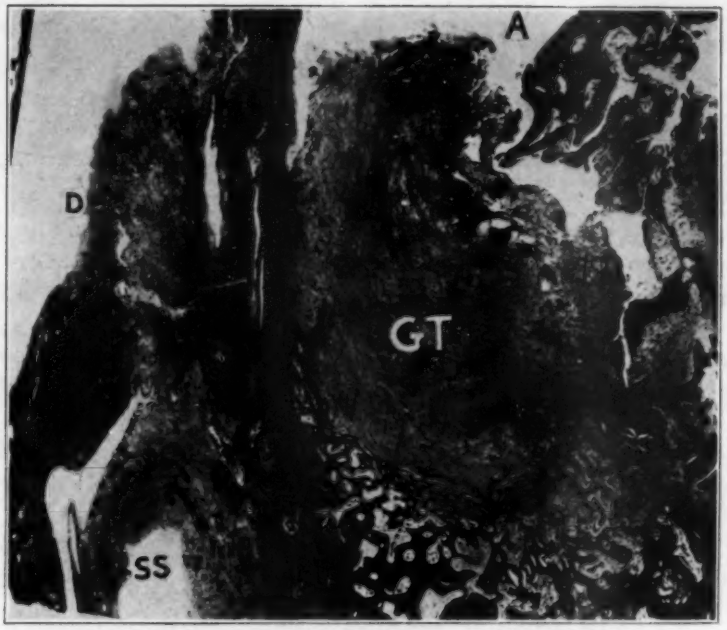

Fig. 6.—Photomicrograph of a vertical section through the antrum (*A*) showing marked inflammatory changes within this cavity. Thrombosis of the sigmoid sinus (*SS*) is present. The adjacent dura (*D*) is markedly thickened and infiltrated. *GT* indicates granulation tissue within the antrum.

Fig. 7.—Photomicrograph of a vertical section through the petrous pyramid showing a well organized thrombus (*T*) in the superior petrosal vein (*SPV*). A tract (*Tr*) of inflamed tissue traverses the petrous pyramid and communicates with the vein.

of the outer wall of the vein is no criterion of the pathologic process present within the lumen. However, on histologic examination inflamed granulation tissue was present on the parietal wall of the sigmoid sinus in the region of the antrum. In all probability the infectious process entered the vein at that site. The saccus endolymphaticus was not involved, so that in all likelihood the infection did not spread from that structure. There were fistulous tracts from the labyrinth to the dura, one of which could be traced to the superior petrosal sinus. These must also be considered as possible pathways in the spread of the

Fig. 8.—Photomicrograph of a vertical section through the cochlea (*C*) showing a purulent labyrinthitis, a marked osteitis of the petrous pyramid and a huge peribulbar abscess (*PA*). *ET* indicates the eustachian tube; *FN*, the facial nerve.

infection to the sinus. The route to the inferior petrosal sinus or jugular bulb via the labyrinthine vein cannot be definitely ruled out.

It must be borne in mind that the infectious organism was the virulent type III pneumococcus. This, added to the fact that the patient had syphilis, rendered the bony substance of the labyrinthine capsule and petrous pyramid more vulnerable to the infectious process. The pain in the teeth was undoubtedly due to the ganglionitis of the fifth nerve associated with the osteitis of the petrous pyramid.

Case 2.—S. P., a man, aged 56, was admitted to the otologic service of Dr. Friesner on Jan. 27, 1931. He had contracted an infection of the upper respiratory tract six months previously. This had persisted up to two months prior to admis-

sion, when he first experienced pain in the left ear, and not until one month later did the ear begin to discharge spontaneously. This was followed one week later by marked dizziness and severe left-sided headaches. Twelve hours prior to admission falling and vomiting set in.

For the past two years the patient had been treated for disease of the coronary artery and mild diabetes. The latter was kept under control.

Physical Examination.—The patient appeared acutely ill. The temperature was 102 F.; the pulse rate, 100. The right ear was normal; the left ear drum was full. No landmarks were discernible. A moderate amount of purulent discharge from a tubal perforation was present. There was tenderness over the entire mastoid. Only a loud spoken voice (noise apparatus in the other ear) could be heard.

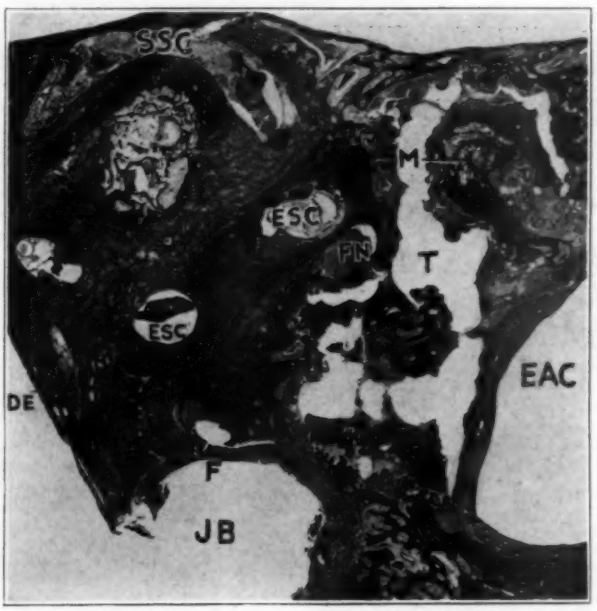

Fig. 9.—Photomicrograph of a vertical section through the tympanum (*T*) showing a purulent labyrinthitis involving the semicircular canals. A fistula (*F*) of the lower pole of the posterior semicircular canal is present communicating with the peribulbar region. *DE* indicates the ductus endolymphaticus; *ESC*, the external semicircular canal; *FN*, the facial nerve; *JB*, the jugular bulb; *M*, the malleus; *EAC*, the external auditory canal; *SSC*, the superior semicircular canal.

Nystagmus of the first degree to the right was present; there was no past pointing. Rigidity of the neck, bilateral Kernig and Brudzinski signs and hyperactive knee jerks were elicited. A provisional diagnosis of suppurative labyrinthitis with meningitis was made.

Course.—Spinal puncture yielded slightly hazy fluid under increased pressure. On smear encapsulated gram-positive diplococci were found. The cell count of the spinal fluid was 3,600 white blood cells, 80 per cent of which were polymorphonuclear leukocytes.

The fundi were normal.

On caloric test the left ear showed a total absence of irritability; the right ear showed normal responses.

While it was agreed that the case was more or less hopeless, operative intervention was nevertheless decided on. A simple mastoidectomy was performed, particular care being taken to avoid excessive trauma. A considerable amount of purulent exudate with marked necrosis of the bone was encountered in the initial groove at the tip and over the sigmoid sinus. A huge perisinuous abscess was found. The dura was exposed over the middle and posterior fossae. A fistula of the labyrinth could not be demonstrated.

A spinal puncture made on the following day showed 2,800 white cells, 93 per cent of which were polymorphonuclears. Gram-negative cocci were disclosed on smear. A culture showed type III pneumococci.

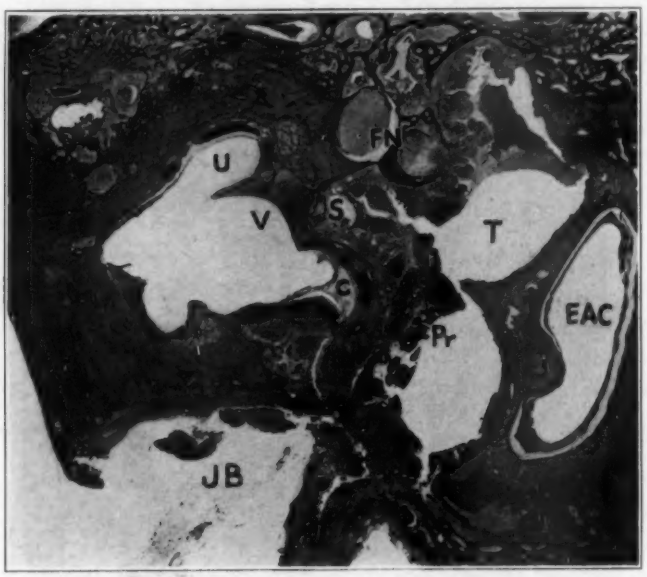

Fig. 10.—Photomicrograph of a vertical section through the vestibule (*V*) showing phlebitis and thrombosis of the jugular bulb (*JB*). A marked necrosis of the jugular dome and lower part of the bony capsule is present. A purulent exudate is present in the tympanum (*T*) and in the vestibule. *C* indicates the cochlea; *EAC*, the external auditory canal; *FN*, the facial nerve; *Pr*, the promontory; *S*, the stapes; *U*, the utricle.

Forty-eight hours after the operation the patient took a sudden turn for the worse. The temperature, which had been relatively normal for three days, abruptly rose to 105 F. He became comatose, pulmonary edema developed, and he died.

Microscopic Examination of the Temporal Bone.—There was a considerable amount of purulent exudate in the eustachian tube and tympanic cavity. The peritubal pneumatic spaces were similarly involved. The infectious process extended into the vestibule and cochlea through the oval and round windows. A diffuse purulent labyrinthitis was present in all the whorls of the cochlea and in the utricle, saccule and semicircular canals (figs. 8, 9 and 10). Organization of this

inflammatory process had begun. Both the perilymphatic and the endolymphatic spaces were involved. The inflammatory process in the tympanum and eustachian cavity had also extended into the perilabyrinthine cells above the labyrinth, particularly at the superior posterior margin of the petrous pyramid and below the labyrinth toward the jugular bulb. A marked osteitis of the petrous pyramid with considerable necrosis of the bone and sequestration was present. A fistula of the lower part of the posterior semicircular canal was present (fig. 9).

Comment.—In this case the severe infection in the middle ear had spread both to the labyrinth and to the petrous pyramid, particularly along the inferior labyrinthine cells. On admission to the hospital clinical signs and symptoms of labyrinthitis and bacterial meningitis were already present. In this case also the entrance of infection from the middle ear into the labyrinth was through the oval and round windows. The infectious process caused necrosis of the floor of the hypotympanum and produced a huge peribulbar abscess and thrombosis of the jugular bulb. The last event was undoubtedly a terminal one, since on histologic examination early changes were noted in the wall of the vessel; frank pus could be demonstrated in the bulb. The fistula in the posterior semicircular canal was probably secondary to the adjacent osteitis; i. e., it spread from without inward. In this case the labyrinthitis could not be held directly responsible for the thrombosis of the jugular bulb. The two conditions were probably the result of the same infectious process in the tympanum. In this case as in case 1 the infectious organism was the type III pneumococcus. The severity of the infection was further enchanced by the presence of diabetes.

SUMMARY AND CONCLUSIONS

Two cases of suppurative labyrinthitis and sinus thrombosis complicating an infection of the middle ear are described. When these two complications coexist they may be independent of each other or one may be the cause of the other. In the latter event the sinus thrombosis is usually secondary to the labyrinthitis. The most common pathways of infection from the labyrinth to the sigmoid sinus are described. These are in brief: (1) preformed pathways (the ductus and saccus endolymphaticus and the labyrinthine veins), and (2) newly formed pathways (erosion of the bony capsule of the labyrinth by a fistula from within outward, through a semicircular canal, usually posterior, and through the body of the labyrinth).

In spite of a carefully elicited history one should be guarded in the diagnosis of an intracranial complication secondary to labyrinthitis. While histologic examination is of tremendous value in establishing the diagnosis, the exact route of extension of the infectious process from the labyrinth to the intracranial contents cannot always be determined.

TREATMENT AND MANAGEMENT OF NONTUBERCULOUS PULMONARY ABSCESS

WITH SPECIAL REFERENCE TO A SERIES OF TWENTY-FIVE CONSECUTIVE CASES

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Articles dealing with nontuberculous pulmonary abscess tend to discuss phases of this subject from the point of view of the internist, bronchoscopist or surgeon. It is my purpose in this article to speak of the treatment and management of nontuberculous pulmonary abscess in general and with especial reference to a series of twenty-five consecutive cases.

The virulence of the infection and the resistance of the patient are fundamental factors in any disease, and in this condition the duration of the illness before the institution of treatment, the possibility of a foreign body, the location of the abscess or abscesses and the presence or absence of the organisms of Vincent's angina, Endamoeba histolytica or tubercle bacilli are of basic importance. The earlier the abscess comes under treatment after its inception, the more amenable it is to the simpler forms of therapy, while the later it comes under observation, the more likely it is that some surgical procedure will be necessary. The history of the possible aspiration of a foreign body forecasts the requirements of a bronchoscopic examination. The location of the abscess or abscesses intimates the type of therapy to which they will be most responsive. Abscesses may be peripheral; parenchymal, central or multiple. When the simpler forms of medical treatment have been tried without improvement of the condition, peripheral abscesses suggest incision and drainage; central and parenchymal abscesses suggest bronchoscopic aspiration or artificial pneumothorax, and abscesses of the lower lobe suggest bronchoscopic aspiration or phrenicectomy. The finding of tubercle bacilli in the sputum places the patient in another category; the discovery of the organisms of Vincent's angina suggests the administration of arsphenamine, and the presence of Endamoeba histolytica suggests the use of emetine hydrochloride.

The following data should be secured in each case, as these findings form a yardstick by which the progress of the disease and the success

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Presented as a candidate's thesis to the American Laryngological, Rhinological and Otological Society.

of a particular form of therapy may be measured: A four hour chart of the temperature, pulse and respiration should be kept. The amount and odor of the sputum should be charted each twenty-four hours and a specimen sent to the laboratory each day until the predominating organisms are discovered, tuberculosis is ruled out and the presence or absence of the organisms of Vincent's angina or of Endamoeba histolytica is determined. The hemoglobin should be recorded every two or three days until convalescence is well established; then it should be recorded at weekly intervals. A complete cell count, urinalysis and roentgen examination of the chest should be made each week until the patient is well on the road to recovery. The Wassermann reaction of the blood should be determined.

The lungs are normally drained by ciliary action, bechic blast and the milking movements of the respiratory passages. Material is carried from the smaller to the larger bronchioles by ciliary motion aided by the expansion and compression of the lungs in respiration until it arrives at trigger areas situated at the spurs between the larger bronchi when the bechic blast is called into play, and the matter is expelled.

The treatment of nontuberculous pulmonary abscess is a rear guard action in which one falls back from the simpler to the more complex methods of therapy if the patient is not making adequate progress, as is instanced by persistent elevation of temperature, pulse and respiratory rates, stationary or increasing amounts of sputum, stationary or dropping weight and roentgenograms revealing an unchanging or advancing lesion. Conversely, however, if these findings reveal improvement and the patient is looking better and gaining weight, strength and appetite one may believe that a particular type of therapy should be continued.

Treatment and management will be considered under three headings: medical, bronchoscopic and surgical.

MEDICAL TREATMENT

Medical treatment may be divided into: basic treatment, consisting of supportive, hygienic and drug therapy; special treatment, i. e., drainage by the tracheobronchial tree aided by postural drainage and by inhalation of carbon dioxide; stimulation of resistance by the administration of blood transfusions, vaccines and nonspecific proteins; specific therapy by medication with arsphenamine, emetine hydrochloride and serum; compression of the abscess by artificial pneumothorax, and physical therapy with ultraviolet irradiation.

At first all nontuberculous pulmonary abscesses should have medical treatment, which should be continued, whatever type of therapy later becomes necessary. The supportive and hygienic therapy of adequate food, rest, fresh air and good nursing may be regarded as fundamental.

Medicines should be largely limited to laxatives, cod liver oil and hematinics. It should be borne in mind that the cough reflex is the watch dog of the lungs and that a "productive" cough is desirable. Cough mixtures tend to upset the stomach. An irritating cough is best limited by the judicious use of tablets of ¼ grain (0.016 Gm.) of codeine sulphate. Night spells of coughing may be relieved or prevented by postural drainage before sleep or when the spasm of coughing occurs.

Sodium perborate should be prescribed as a dentifrice and mouth wash as many normal mouths contain the organisms of Vincent's angina and it is not entirely clear whether these organisms are primary or secondary invaders in this disease.

Postural drainage is the sheet anchor of medical treatment. The patient may either lie across the bed with the diseased side uppermost and with the head and shoulders resting on a chair at a lower level, or lie across the bed on his stomach with his head and shoulders resting on a chair or on a pillow on the floor; a tilting table may be used or, with very sick patients, the foot of the bed may be elevated. When the patient is in position, he should be instructed to take a number of long breaths to stimulate the flow of secretion. The purpose of postural drainage is to evacuate pus, and when this has been accomplished there is no further need for the patient to remain in an uncomfortable attitude. More may be achieved by having the patient assume the drainage position five or six times a day for a sufficient length of time to empty the abscess than by arbitrarily ordering that the position be maintained for any specific period.

Initially all the patients in this series had basic medical treatment and postural drainage. Seven (cases 1 to 7) made complete recoveries; seventeen were later given other types of treatment, and one (case 8) died. The last mentioned patient entered the hospital six weeks after the onset of the pulmonary symptoms. She was practically moribund on entrance and died five days after admission.

Ten per cent carbon dioxide in oxygen is administered to stimulate and deepen respiration. Alexander and Buckingham [1] have used it early in pulmonary abscess in the hope that the exaggerated respiratory movements would dislodge tenacious secretion and thereby promote drainage. While I have not tried this procedure in pulmonary abscess, I obtained good results by using it immediately before postural drainage in a patient with an acute bronchiectasis that did not drain well by posture alone; later, in order to eliminate expense, I had the patient manufacture his own carbon dioxide by rebreathing in a paper bag.

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1. Alexander, J., and Buckingham, W. W.: Treatment of Nontuberculous Suppurative Pneumonitis, Abscess and Bronchiectasis, J. A. M. A. **95**:1478 (Nov. 15) 1930.

Transfusions of whole blood should be given when the hemoglobin falls below 50 per cent, in order to bring the patient's blood to a more nearly normal quantity and quality. Frequent small transfusions of whole blood may also add new defense elements to a patient hovering about the turning point of his resistance.

One of the patients (case 8) was given transfusions in order to tide her over until another type of treatment could be used. Another (case 25) received three small transfusions which apparently hastened his recovery.

The use of vaccines in the treatment of this condition has been suggested by Lukens [2] and others. Material for cultures for vaccines is best obtained by bronchoscopic aspiration.

Autogenous vaccines were used in six of the patients (cases 11, 12, 13, 17, 19 and 25) after they had passed the peak of the sickness and begun to convalesce, with no definite results.

The use of nonspecific proteins in a disease that frequently runs a protracted course, in which drainage is fundamental and in which material for cultures for autogenous vaccines may easily be obtained does not seem logical.

A nonspecific substance containing albumin, lipoid and fat was twice given to one patient (case 9) who made an uneventful recovery under basic medical treatment and postual drainage. There was no reason to believe that this substance played any part in her recovery.

Arsphenamine should be administered if the organisms of Vincent's angina are found in the sputum.

Seven patients in this series had the organism of Vincent's angina in the sputum and six (cases 11, 17, 18, 19, 20 and 25) were treated with arsphenamine. None were cured, but all improved. Three patients (cases 11, 17 and 19) had undergone a prolonged period of sickness and were raising over 24 ounces (680 Gm.) of foul sputum a day. Treatment was continued at weekly intervals until the laboratory reported the absence of these organisms for six days. As the infection subsided, the odor of the sputum disappeared and the amount diminished to 4 ounces (56 Gm.) in a twenty-four hour period.

Pulmonary abscesses due to Endamoeba histolytica have rarely been reported in this country. According to Lautman,[3] they are always secondary to amebic dysentery. The possibility that Endamoeba histolytica may be the offending organism should be borne in mind par-

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2. Lukens, R. M.: Pulmonary Abscess and Bronchiectasis: A Bronchoscopic Study, Tr. Am. Laryng., Rhin. & Otol. Soc., 1925, p. 369.

3. Lautman, A.: Contribution à l'étude de l'amibiase pulmonaire, Thèse de Paris, no. 102, Paris, Amédée LeGrand, 1932, p. 80.

ticularly with patients who have resided in the tropics. If the presence of that organism is determined, emetine hydrochloride should be administered.

In none of the cases under consideration was Endamoeba found to be the offending organism.

In Russia Voroshilsky [4] reported a cure resulting from the use of antistreptococcus serum in eight cases of pulmonary abscess in which streptococci were the invading organisms. This treatment was tried in one case of the present series. The patient (case 10), aged 44, had in the upper lobe of the left lung a parenchymal abscess of unknown etiology and of one month's duration. He was doing well under medical treatment and underwent one bronchoscopic aspiration. Examination of the specimen thus obtained revealed a pure culture of hemolytic streptococci. Five days after the bronchoscopy he was given 6,000 units of a polyvalent streptococcus serum and twenty-four hours later he died. No autopsy was obtained. This was a type of case in which one would have expected recovery under medical treatment and bronchoscopic aspiration. Death may have been due to an anaphylactic reaction.

Artificial pneumothorax may be used in the treatment of nontuberculous pulmonary abscesses that are draining well by the tracheobronchial tree. This form of treatment is most applicable to abscesses in the upper lobes in which adhesions form late.

In this form of treatment from 100 to 150 cc. of air or gas is introduced into the pleural cavity at from intervals of two to five days until the roentgenogram shows that the involved lung is adequately collapsed. The lung is then held at this state of compression by occasional refills until at least four months have elapsed. It may be reasoned that if a thoracoplasty by compression alone permits a pulmonary abscess to heal, this may be accomplished by an artificial pneumothorax, provided that the lung is held collapsed for a sufficient period. If this form of therapy is used, medical treatment including postural drainage should be continued, and any fusospirillary infection should be eradicated.

Artificial pneumothorax is most successful in the control of the types of lesions that are most amenable to basic medical treatment, postural drainage and bronchoscopic aspiration. When this form of treatment is used there is danger of breaking adhesions, tearing pulmonary tissue and setting up a pleural infection; furthermore, peripheral abscesses may be ruptured into the pleural cavity with disastrous results.

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4. Voroshilsky, Y. S.: The Radical Cure of Lung Abscess with Injections of Antistreptococcic Serum, Odessky med. **5**:300, 1930.

It is of interest to note that Faulkner [5] has used artificial pneumothorax in conjunction with roentgenograms to outline adhesions which have hindered healing by preventing the collapse of the abscessed lung.

Artificial pneumothorax is of real value in controlling hemorrhages occurring in the course of this disease, provided that pleural adhesions do not prevent the collapse of the lung. This type of treatment was used in two of the twenty-five cases under consideration. In case 19 adhesions prevented the introduction of the gas, while in case 11 the patient was cured. This patient was 53 years of age. His abscess was of unknown etiology and was centrally located in the lower lobe of the right lung. He entered the hospital on Aug. 28, 1931, with a history of profuse expectoration for four months. On September 3 organisms of Vincent's angina were found in his sputum. He received five doses of neoarsphenamine (0.45 Gm.) at weekly intervals. The amount and odor of the sputum diminished, and it seemed as if he would make a recovery with basic medical treatment, postural drainage and the use of arsphenamine. However, he acquired an influenzal cold and on October 1 began to have a series of pulmonary hemorrhages. On October 5 an artificial pneumothorax was produced, and in the next few days his lung was adequately collapsed with the cessation of the hemoptysis. Refills were introduced at weekly intervals until mid-December. He was discharged from the hospital on Feb. 1, 1932. Roentgenograms of his chest a year later revealed no evidence of the abscess.

Nontuberculous pulmonary abscess is a depressing disease. Generalized treatment with ultraviolet irradiation has been found of tonic and psychic value particularly in the convalescence in protracted cases.

BRONCHOSCOPIC TREATMENT

Bronchoscopic treatment is an adjunct to, but does not supplant, medical therapy. Its peculiar function is to aspirate tenacious secretions, thereby aiding ciliary activity. Under local anesthesia a bronchoscope is introduced into the bronchus proximal to the abscess, and an aspirating tube is inserted. Neither the bronchoscope nor the aspirating tube usually enters the cavity of the abscess. Thick secretions may be thinned by irrigation with suitable solutions; granulations in the proximal bronchus may be crushed and medication introduced into the cavity. Aspirations are performed at intervals of from five to seven days.

Centrally located and parenchymal abscesses of the upper and middle lobes are most amenable to this form of therapy, while parenchymal abscesses of the lower lobes do not respond as well. Peripheral abscesses

5. Faulkner, W. B., Jr.: Diagnostic Pneumothorax; Guide in Localization Treatment, and Prognosis of Pulmonary Abscesses, Am. J. Surg. **14**:646, 1931.

are not suited to bronchoscopic treatment since they may rupture into the pleural cavity with the cough accompanying this procedure. Bronchoscopy should not be performed if there has been a recent pulmonary hemorrhage. If the patient has not made a definite response to medical treatment and postural drainage in two or three weeks regardless of the position of the abscess, he should undergo a bronchoscopic aspiration unless there is some definite contraindication, not merely for the purpose of aspiration but also to rule out the possibility of a foreign body nonopaque to roentgen rays, new growths, etc. The localization of pulmonary abscesses by bronchoscopy and roentgen rays, as suggested by Kramer and Glass,[6] is of importance to the thoracic surgeon.

Ten of the twenty-five patients were treated bronchoscopically, and six were cured. Two were sent to the surgeons; one of these (case 25) recovered after an incision and drainage and the other (case 19) after a thoracoplasty. One (case 10) was given antistreptococcus serum and died, and in another (case 18) tuberculosis developed. Nine days after a radical operation on the antrum, performed under a general anesthetic, the last mentioned patient had a chill followed by a "productive" cough. Prior to this procedure many carefully performed physical examinations had revealed no abnormality in the chest. This case was included in this series as it shows that tuberculosis with the formation of a cavity may develop quickly and yet the history and roentgenographic and physical findings may be consistent with a nontuberculous pulmonary abscess. Examinations of the sputum repeatedly gave negative results until tubercle bacilli were found in material obtained at the third bronchoscopy.

In the cases in which cure took place bronchoscopic aspiration was begun about a week after the onset of the disease in cases 12, 13 and 14, about three weeks after onset in cases 15 and 16 and at the end of seven weeks in case 17. Four abscesses were located in the parenchyma of the upper lobes (cases 12, 14, 15 and 16) and one in the parenchyma of a lower lobe (case 13); and in one instance (case 17) abscesses were located centrally in the middle and lower lobes of the right lung. Four patients (cases 13, 14, 15 and 16) each underwent four bronchoscopic aspirations; one patient (case 12), three, and the remaining patient (case 17), eleven. Three were losing ground under medical treatment and postural drainage; two of these (cases 15 and 16) began to improve after the first bronchoscopies, while the third (case 17) received in addition to eleven bronchoscopic aspirations seven injec-

6. Kramer, R., and Glass, A.: Bronchoscopic Localization of Lung Abscess, Ann. Otol., Rhin. & Laryng. **41**:1210, 1932.

tions of neoarsphenamine, as he had a fusospirillary infection. He gained 53 pounds (24.04 Kg.) in the five months that he was under treatment.

SURGICAL TREATMENT

Surgical treatment will be discussed under the following captions: compression of the abscess by phrenicectomy, thoracoplasty, extrathoracic and intrathoracic pneumolysis, incision and drainage and lobectomy.

Surgical intervention is the last line of defense in the treatment of nontuberculous and pulmonary abscess. It should not be attempted until local tissue resistance has been set up, from six to eight weeks after the onset of the disease, or delayed until there is little likelihood of restoring the abscessed lung to normal without destruction of tissue. An operation should not be attempted until other forms of treatment have failed.

Interruption or avulsion of the phrenic nerve by paralyzing the diaphragm on the involved side is best suited for the treatment of parenchymal abscesses of the lower lobe. Phrenicectomy destroys the pumping action of the diaphragm, thereby limiting the drainage of the lung to ciliary activity and bechic blast. It is a simple operative procedure with little risk and does not preclude the use of postural drainage, bronchoscopic aspiration, artificial pneumothorax, incision and drainage or thoracoplasty. This method has not been used in any of the cases under consideration.

Thoracoplasty by removing parts of several ribs directly over the involved area permits external pressure to compress the abscess. It is of greatest use in the treatment of soft-walled parenchymal abscesses of the middle or upper lobes that are draining well by the tracheobronchial tree. For anatomic reasons abscesses of the lower lobe cannot be compressed as well by this means alone, and an interruption of the phrenic nerve may aid materially by paralyzing the diaphragm on the involved side. Peripheral, central or parenchymal abscesses with thick walls or extensive destruction of tissue are best treated by other methods. Thoracoplasty does not preclude the use of external drainage by incision or cautery, should these procedures later become necessary.

Thoracoplasty was performed on two of the patients, with one recovery and one death. The patient (case 19) who recovered was 10 years of age; an abscess had developed in the parenchyma of the upper lobe of the left lung after a tonsillectomy in June, 1928. Shortly after this operation pulmonary symptoms appeared, and the patient went from one physician to another until she was sent to a sanatorium for tuberculosis in June, 1929. Organisms of Vincent's angina were found in her sputum, and she received ten injections of sulpharsphenamine. She was improved but not cured. Artificial pneumothorax was then

attempted, but adhesions interfered with this procedure. She was finally discharged from the sanatorium as repeated examinations of the sputum showed no tubercle bacilli. She was admitted to the hospital in December, 1929, and three bronchoscopic aspirations were performed at weekly intervals without improvement in her condition. Late in January, 1930, she had a series of severe pulmonary hemorrhages following an acute infection of the upper respiratory tract. In March, 1930, a thoracoplasty was performed. She made a complete recovery and has since remained completely well.

The patient who died (case 20) was 16 years of age and entered the hospital on Sept. 7, 1928, with an indefinite history of excessive cough of four years' duration. Multiple abscesses were found in the lower lobe of the right lung. He was placed on basic medical treatment and postural drainage, with little improvement. Organisms of Vincent's angina were found in his sputum, and he was given one injection of neoarsphenamine. On September 19 a portion of the ninth rib was removed extrapleurally under paravertebral anesthesia. On October 23 portions of the eighth and tenth ribs were removed. Despite the fact that his temperature remained normal, he gradually lost ground and died on November 9.

Extrapleural pneumolysis is a modification of thoracoplasty in which no portions of the ribs are removed but pressure is exerted by means of a rubber bag or other substance inserted between the ribs and the parietal pleura in order to collapse the abscessed area. In this procedure the ribs are used as counterpoints for pressure; the thorax is not deformed, and incision and drainage may be performed later if necessary.

This procedure was undertaken in one instance. The patient (case 21) was 22 years of age and entered the hospital on Oct. 5, 1932. An abscess was located in the parenchyma of the lower lobe of the left lung and dated from the extraction of a tooth on April 30. She was placed on a basic medical treatment and postural drainage, with no improvement in her condition. On November 15 an extrapleural pneumolysis was performed; as this resulted in no amelioration in her symptoms an incision and drainage were undertaken on November 30, after which she made a slow recovery, being discharged from the hospital on Feb. 28, 1933.

Intrapleural pneumolysis is a procedure developed by Jacobaeus,[7] in which a thoracoscope is introduced into the pleural cavity and adhesions that prevent the complete collapse of the lung by artificial pneumothorax are severed under visual observation. This method has been used

7. Jacobaeus, H. C.: Endopleurale Operationen unter der Leitung des Thorakoskops, Beitr. z. Klin. d. Tuberk. **35**:1, 1915.

in conjunction with artificial pneumothorax in selected cases of pulmonary tuberculosis and may be applicable to the treatment of certain pulmonary abscesses. I have had no experience with this method.

Incision with drainage is the surgical procedure best adapted to the treatment of peripheral pulmonary abscesses and may be used for parenchymal abscesses that have not responded to nonsurgical therapy. Adhesions between the visceral and parietal pleurae at the point of incision are a prerequisite for the procedure. Their presence may be determined by a careful fluoroscopic examination. If there is any doubt as to their existence or extent, the operation should be performed in two stages; first, portions of the ribs extrapleurally over the site of the abscess should be excised and the wound packed with gauze for four or more days; then the abscess may be incised with a knife, endotherm knife or actual cautery. The success of this procedure in certain instances may be enhanced by the wide removal of tissue peripheral to the abscess, so that the cavity may be obliterated by the external pressure of the packing plus that due to the internal expansion of the lung aided by the diaphragm. The use of rubber tubes for drainage is not without danger, as they may by pressure erode blood vessels and cause hemorrhage.

Of five patients treated by incision and drainage four recovered and one died. The patient who eventually died (case 22) entered the hospital on Dec. 5, 1931. He was 51 years of age and had had a lobar pneumonia of the lower lobe of the left lung for six days. On December 16 a roentgenogram showed a peripheral abscess in that lobe. He was placed on basic medical treatment and postural drainage; the latter caused great discomfort, probably owing to tension on fresh adhesions, and had to be discontinued. On December 24 a portion of a rib peripheral to the abscess was removed extrapleurally and the wound packed. On December 29 the abscess was incised and drainage instituted. On January 1 the patient died from hemorrhage from the wound.

Of the patients who recovered the one (case 21) who was treated by pneumolysis followed by incision and drainage has been mentioned. Two cases (cases 23 and 24) followed lobar pneumonia that resolved slowly. The diagnosis of pulmonary abscess was made from roentgenograms. Empyema subsequently developed in these patients, and they recovered after operation. The remaining patient (case 25) entered the hospital in July, 1929, twenty days after lobar pneumonia. Roentgenograms revealed a pulmonary abscess high in the middle lobe. Subsequent pictures showed an interlobular empyema. This ruptured into a bronchus. The patient received basic medical treatment, postural drainage, vaccine, neoarsphenamine and bronchoscopic aspirations without avail; he did, however, make a stormy recovery after an incision and drainage.

The cautery method of Graham [8] is an extension of simple incision and drainage, consisting of a wide débridement of diseased pulmonary tissue with the actual cautery; it is of value in extensive abscess or abscesses of one lobe that have not yielded to other forms of treatment. In this operation bleeding can be controlled because of the low pressure in the pulmonary vessels. I have had no experience with this method.

Lobectomy is a procedure better adapted to the treatment of a unilobular bronchiectasis than to a pulmonary abscess.

TABLE 1.—*Type of Treatment Used in Reference to the Location of the Pulmonary Abscess*

	Location of Abscess in the Lobe			
Lobe	Parenchymal	Central*	Peripheral	Multiple
Right, upper	Bronchoscopy Incision	.....	Basic	
Left, upper	Antistreptococcus serum (died) Bronchoscopy Bronchoscopy Bronchoscopy Bronchoscopy, developed tuberculosis Thoracoplasty			
Right, middle	.....	Bronchoscopy		
Right, lower	Incision	Basic Basic Basic Bronchoscopy Pneumothorax	.....	Basic (died) Thoracoplasty (died)
Left, lower	Basic Basic Basic Basic and nonspecific substance containing albumin, lipoid and fat Bronchoscopy Incision	.....	Incision Incision (died)	

* One patient (case 17) treated by bronchoscopic aspiration had central abscesses in the middle and lower lobes of the right lung.

COMMENT

Patients with nontuberculous pulmonary abscesses should be guarded against intercurrent respiratory infections while undergoing hospitalization. Influenzal colds developed in two patients in this series while under treatment. One patient (case 11) who finally made a complete recovery after artificial pneumothorax was making adequate progress with basic medical treatment and neoarsphenamine until an influenzal cold precipitated pulmonary hemorrhages. Another (case 19) who had a parenchymal abscess of one and a half years' duration and who eventually recovered after a thoracoplasty acquired an influenzal cold which was followed by severe pulmonary hemorrhages.

Table 1 shows the principal types of therapy that were used in reference to the locations of the abscesses.

8. Graham, E. A.: The Rôle of Surgery in the Treatment of Pulmonary Suppuration, J. A. M. A. **85**:181 (July 18) 1925.

TABLE 2.—*Types of Treatment* *

Case	Age	Etiology	Lobe					Type of Treatment															Died	Cured	Day from Onset to Treatment	Days from Treatment to Recovery, to Death	Total Number of Days of Illness
			Right Upper	Right Middle	Right Lower	Left Upper	Left Lower	Basic	Posture	Transfusion	Vaccine	Nonspecific Protein	Arsphenamine	Serum	Pneumothorax	Ultraviolet Irradiation	Bronchoscopy	Thoracoplasty	Pneumolysis	Incision and Drainage					
1	23	Herniotomy, bronchopneumonia 7 days later, pulmonary abscess 22 days later	..	..	..	..	+†	+	+	..	..	..	..	..	..	..	..	..	..	..	..	+	0	16	16
2	44	Tonsillectomy	..	..	..	..	+†	+	+	..	..	..	..	..	..	..	..	..	..	..	..	+	27	9	36
3	42	Boil in nostril, blood stream infection, bronchopneumonia 14 days later, pulmonary abscess 8 days later	..	..	+‡	..	..	+	+	..	..	..	..	..	..	+	..	..	..	..	..	+	0	40	40
4	36	Appendicitis, peritonitis, bronchopneumonia 1 day later, pulmonary abscess 18 days later	..	..	+‡	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..	..	+	0	49	49
5	19	Septic abortion	..	..	..	..	+†	+	+	Died 36 days later, septicemia, pulmonary abscess cured						+	..	..	..	..	..	+	0	54	..
6	38	Tooth extracted	+§	..	..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..	..	+	30	49	79
7	38	Chronic bronchitis	..	..	+‡	..	..	+	+	..	..	..	..	..	..	+	..	..	..	..	..	+	70	28	98
8	19	Tonsillectomy	..	..	+‖	..	..	+	+	+	Moribund on entry				..	..	..	..	..	..	+	..	43	5	48
9	18	Lobar pneumonia	..	..	..	..	+‡	+	+	..	..	+	Nonspecific substance containing albumin, lipoid and fat						..	..	..	+	6	40	46
10	44	Unknown	..	..	..	+†	..	..	..	..	..	..	..	+	..	..	+1 Antistreptococcic serum		..	..	+	..	30	7	37
11	53	Unknown	..	..	+‡	..	..	+	+	..	+	..	+5	..	+	+	..	..	..	..	..	+	180	157	337

12	42	Appendectomy, mucocele, streptococcic blood stream infection 51 days later, pulmonary abscess 46 days later	..	..	..	+†	..	+	+	..	+	..	..	..	..	+	+3	..	..	..	..	+	0	20	20
		Died 164 days later, sacro-iliac abscess																								
13	15	Bronchitis	..	..	..	..	+†	+	+	..	+	..	..	..	..	..	+4	..	..	..	..	+	10	23	33
14	41	Unknown	+†	..	..	..	..	+	+	..	..	..	..	..	..	+	+4	..	..	..	..	+	8	30	38
15	54	Influenza	..	..	..	+†	..	+	+	..	..	..	..	..	..	..	+4	..	..	..	..	+	21	25	46
16	63	Influenza	..	..	..	+†	..	+	+	..	..	..	..	..	..	..	+4	..	..	..	..	+	49	13	62
17	44	Tonsillectomy	..	+‡	+‡	..	..	+	+	..	+	..	+7	..	..	+	+1	..	..	..	..	+	29	84	113
18	32	Radical operation on antrum	..	..	..	+†	..	+	+	..	..	..	+3	..	..	..	+3	..	..	..	..	..	..	..	..
		Typical history of abscess; developed tuberculosis																								
19	10	Tonsillectomy	..	..	..	+†	..	+	+	..	+	..	+10	..	..	+	+3	+	..	..	..	+	365	344	709
20	16	Chronic bronchitis	..	..	+‖	..	..	+	+	..	..	..	+1	..	..	..	..	+	..	..	+	..	4 yrs.	62	1,522
21	22	Tooth extracted	..	..	..	..	+†	+	+	..	..	..	..	..	..	..	..	..	+	+	..	+	158	146	304
22	51	Lobar pneumonia, pulmonary abscess 17 days later	..	..	..	..	+§	+	+	..	..	..	..	..	..	..	..	..	..	+	+	..	0	17	17
23	5	Appendectomy, pneumonia 3 days later, pulmonary abscess 12 days later	..	..	..	..	+§	+	..	..	..	..	..	..	..	..	..	..	..	+	..	..	0	82	82
24	10	Lobar pneumonia, pulmonary abscess 16 days later	..	..	+†	..	..	+	+	..	..	..	..	..	..	..	..	..	..	+	..	..	0	82	82
25	3	Lobar pneumonia, pulmonary abscess 20 days later	+†	..	..	..	..	+	+	+	+	..	+1	..	..	+	+5	..	..	+	..	+	0	241	241

* In the columns marked "Arsphenamine" and "Bronchoscopy" the numerals following + indicate the number of treatments.
† Parenchymal abscess.
‡ Central abscess.
§ Peripheral abscess
‖ Multiple parenchymal abscesses.

Table 2 is worthy of study, for in addition to recording the ages of the patients and the etiology of the abscesses in reference to treatment, it tabulates the various therapeutic procedures used; it clearly shows that the earlier the patient comes under adequate treatment after the onset of the disease, the greater the possibility of cure, and the later he comes under adequate treatment the more perplexing the problems of therapy.

CONCLUSIONS

The successful treatment of a nontuberculous pulmonary abscess requires the cooperation of the internist, bronchoscopist, surgeon, bacteriologist and roentgenologist. All the patients with this condition should be admitted to some particular service and studied by a group of physicians interested in this disease rather than cared for on a general service.

The earlier adequate treatment is instituted after the onset of the disease, the greater is the hope for the recovery of the patient.

The type of therapy must be suited to the particular case. Basic medical treatment is fundamental whatever other type of therapy is employed; sodium perborate should be prescribed as a dentifrice as a routine; postural drainage is of value at some time in the management of almost every case; inhalations of carbon dioxide should be borne in mind; transfusions play an important part in supportive therapy; vaccines are worthy of trial; nonspecific proteins do not seem logical; arsphenamines should be used if the organisms of Vincent's angina are found in the sputum; emetine hydrochloride should be administered if Endamoeba histolytica is found to be the offending organism; specific serums do not seem logical; artificial pneumothorax is of real worth in the treatment of parenchymal and central lesions and in the treatment of hemorrhages arising in the course of this disease; physical therapy is of tonic and psychic value.

Bronchoscopic aspiration is the most valuable form of therapy, second to postural drainage, in the treatment of this condition. It is also of value in differential diagnosis and in conjunction with roentgen rays in the localization of the abscess.

Phrenicectomy may be used in the treatment of parenchymal abscesses of the lower lobes and may be employed as an aid in collapsing the lung by artificial pneumothorax; thoracoplasty is of worth in the treatment of soft-walled parenchymal abscesses that are draining well by the tracheobronchial tree; extrapleural pneumolysis is a modification of thoracoplasty; intrapleural pneumolysis may prove of value in conjunction with artificial pneumothorax; incision with drainage is the treatment *par excellence* for peripheral abscesses; lobectomy is better adapted to the treatment of unilobular bronchiectasis.

A series of twenty-five cases of pulmonary abscess have been discussed. Of the patients who recovered, seven had basic medical treatment and postural drainage; one had basic medical treatment plus a nonspecific substance containing albumin, lipoid and fat; one had an artificial pneumothorax; six had bronchoscopic aspirations; one had a thoracoplasty, and four had incisions and drainage. Of the patients who died, one who was moribund on entry to the hospital had medical treatment and postural drainage; one who had been ill for four weeks had antistreptococcus serum; one had a thoracoplasty; one had an incision and drainage. Tuberculosis developed later in one patient.

The recovery rate in this series is 83.3 per cent.

47 Deering Street.

IMPROVED OPERATIVE TECHNIC FOR SUPPURATION OF THE PETROUS APEX

M. C. MYERSON, M.D.
H. W. RUBIN, M.D.
AND
J. G. GILBERT, M.D.
NEW YORK

We propose an improved operative technic for the approach to the apex of the petrous portion of the temporal bone by way of the middle fossa. Several operators have approached this region by this route, but in their procedures landmarks and instrumentation have not been stressed so as to clarify and simplify the technic. In most instances the petrous apex was exposed but not entered. When the area of the apex was entered, a hook or a curet was used. The operation which we describe is an attempt to simplify and, if possible, to define the technic so that it will be readily available to the otologic surgeon.

In one of his excellent articles Kopetzky has reviewed the various technics which have been used or advocated and has rendered his critique. Our review of the literature on this subject and our understanding of the pathologic nature of suppuration of the petrous pyramid lead us to incline toward the policy that a radical mastoidectomy should be avoided, whenever possible, so as to preserve the hearing. This applies especially to children, whose hearing is so essential to a proper mental development.

Thus far two operations have been described which propose a well defined technic, that of Kopetzky and Almour and that of Eagleton. By the procedure of Kopetzky and Almour an attempt is made to enter the apex by circumventing the labyrinth. Their operation requires an approach through the middle ear and a preliminary radical mastoidectomy. The other operation is that of Eagleton. He removes what he terms the anterior and posterior buttresses; this affords an exposure of the middle and posterior fossae, in their relation with the petrous pyramid. He carries his exposure of the anterior surface as far as the apex, while posteriorly the exposure goes as far as the internal auditory meatus after the saccus endolymphaticus has been severed. A radical mastoidectomy is required as a part of this operation. We are mindful of the existence of a fistula from the region of the petrous apex into

From the Department of Otolaryngology, Kings County Hospital.

the middle ear in a certain percentage of cases, but this article deals with a technic to be used when the judgment of the operator suggests a trapped infection in the petrous apex which requires drainage.

The operation which we propose is more conservative and can be considered as a modification of the procedure of Eagleton. Our aim is to simplify the operation by drawing attention to landmarks and to the technic. Certain landmarks are observed and certain relationships noted. In addition we use especially designed instruments for special purposes.

TECHNIC OF OPERATION

The preexisting mastoid wound is enlarged. A vertical cutaneous incision is made from the uppermost attachment of the auricle about

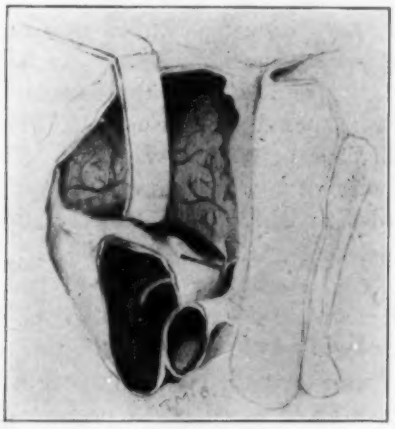

Fig. 1.—Area showing the removal of bone and the exposure of the anterior surface of the petrous pyramid as far as the tip. Note the elevations and depressions which are used as guides.

2½ inches (6.35 cm.) upward. A large section of the squamous bone is removed. This removal of the bone extends down to the zygoma anteriorly and to the knee of the sigmoid sinus posteriorly. The area removed is approximately 4 cm. in diameter. In addition the tegmen of the mastoid is removed and also a part of the tegmen tympani as far as the prominence of the superior semicircular canal. Elevation of the temporal lobe is first carried out along the anterior surface, hugging the superior border of the pyramid. In the process of separation some resistance is encountered along the superior border from the prominence of the superior canal inward as far as the internal margin of the internal auditory meatus. The resistance is lessened as this point in the separation is reached. At the same time this point marks the beginning of the apical area.

The evolution of this technic has been based on a comprehensive review of the literature and a detailed anatomic study of two hundred petrous portions of the temporal bone in one hundred autopsies. These bones were studied both in their normal condition and relationship within the skull with the brain intact and after they had been excised. Roentgenographic studies of the detached petrous bones were also made. The ideas embodied in this article were developed as a result of this anatomic study. The results of the study are being reported. In addition we have used an approach to the petrous apex by way of the middle fossa in the living on two occasions.

In all but two of the two hundred bones examined we found the following arrangement, which is constant and important in making this

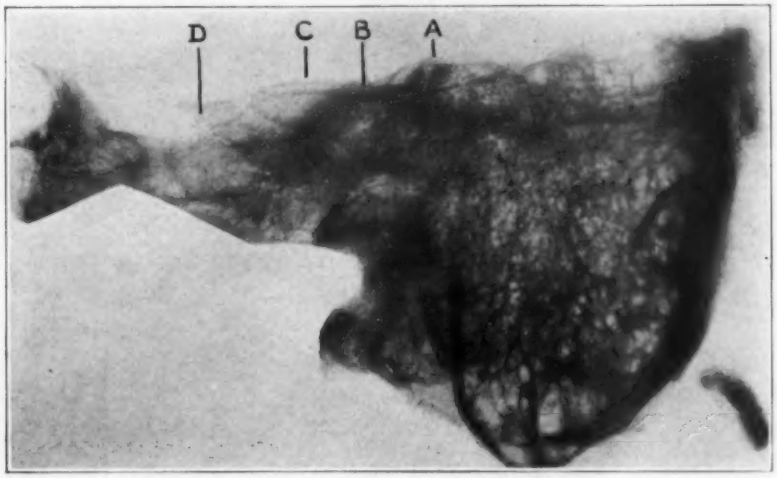

Fig. 2.—Roentgenogram of a pneumatized mastoid process and petrous pyramid illustrating: *A*, elevation, the eminence above the superior semicircular canal; a cross-section of this canal is demonstrated; *B*, depression, region of the subarcuate fossa; *C*, elevation, prominence of the internal auditory meatus; *D*, depression, petrous apex.

operation a safe one: If the anterior surface (called "superior" by most authors but "anterior" by anatomists) of the petrous pyramid is studied, one encounters from without inward an elevation, then a depression, then a second elevation and then a second depression. This sequence of elevation and depression is more marked in some bones than in others. The following structures are responsible for these landmarks: first elevation, an eminence above the superior semicircular canal; first depression, the area between the eminence above the superior semicircular canal and the external lip of the internal auditory meatus; posteriorly it corresponds with the region of the subarcuate fossa;

anteriorly it marks the location of the beginning of the greater superficial petrosal nerve as it leaves the genu of the facial nerve; second elevation, upper lip and roof of the internal auditory meatus; second depression, petrous apex.

Everything internal to the internal auditory meatus constitutes the petrous apex. The elevations and depressions just mentioned come into

Fig. 3.—Point of placement of the gouge in uncapping the petrous apex.

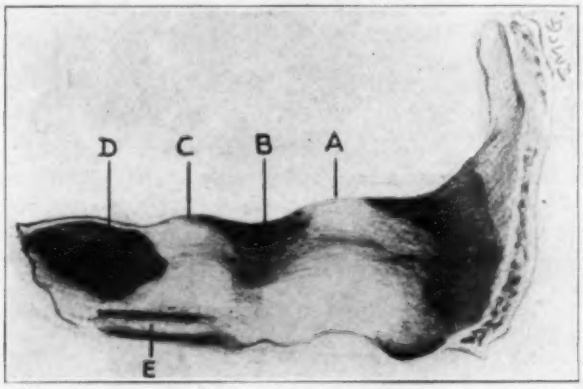

Fig. 4.—A petrous pyramid in which the apical area has been excavated by the technic described: *A*, elevation, eminence above the superior semicircular canal; *B*, depression, region of the subarcuate fossa; *C*, elevation, prominence of the internal auditory meatus; *D*, depression, petrous apex; *E*, carotid artery shown semidiagrammatically.

view when the temporal lobe is elevated. When the elevation proceeds as far as the internal auditory meatus one can see anteriorly and inferiorly the middle meningeal artery emerging from the foramen spinosum (fig. 1). A line drawn directly backward from the foramen

spinosum will always pass through the internal lip of the internal auditory meatus. This is a constant relationship and serves as a check to assure the operator that he is entering the apical area during the operation. The greater superficial petrosal nerve can be seen lying anteriorly in the first depression and running parallel to the long axis of the petrous pyramid. The third division of the fifth nerve can be seen in the dura 2 mm. internal to the foramen spinosum. Roentgenographic studies of the excised petrous bone clearly demonstrated the elevations and depressions (fig. 2).

INSTRUMENTATION

The exposure outlined permits inspection of the epitympanic space and of the region of the external and superior semicircular canals posteriorly for the presence of fistulas. After the inspection and search for a fistula we place a gouge of appropriate size with a squarely cut off end, beveled on the inside and with the distal end at an angle of 135 degrees from the shaft at a point slightly external to the beginning of the second depression and on the anterior surface as close to the superior border as possible (fig. 3). The direction is parallel to the superior border. In this way the carotid artery is kept far from the path of the gouge. A slight tap with the mallet or firm pressure with the hand and a downward motion of the handle will uncap a portion of the roof of the apex. The remainder of the apical area is uncapped and excavated by means of specially designed curets. The posterior lip of the cavity, all of which lies internal to the internal auditory meatus can then be shaved down with a special curet. A large curved suction tube is used after the curetting is completed. This tube serves to remove the contents of the cavity and also any spicules of bone which may have been left behind. In addition the suction is applied to the external wall of the cavity of the petrous apex so as to evacuate pus which might be retained in any of the groups of cells leading to it. The end-result of this procedure is a cavity which consists of everything in the petrous portion of the bone beyond the labyrinth and the internal auditory meatus (fig. 4). A rubber drain is inserted, and the temporal lobe is permitted to drop back into place. The wound is closed, and the drain is allowed to protrude through the lower end of the wound.

Clinical Notes

NEW ADAPTATION OF X-RAY PRINTS AND SLIDES (DEMONSTRATION)

WALTER H. THEOBALD, M.D., CHICAGO

Photographic prints of x-ray films used for publication up to the present have been more or less unsatisfactory. For a long time physicians have felt the need of perfecting the details of x-ray pictures so that they might be used more effectively in illustrative work. The positive x-ray prints which one sees in textbooks require description in detail, and many of them have to be retouched. Likewise, lantern slides made from x-ray films lose much of their detail and require considerable identification when they are presented.

The process by which the photographs exhibited here are made consists in first printing a positive film of the original negative. In other words, two films are necessary to attain these results. Although the idea of using both a positive and a negative film has been expounded for various purposes in ordinary photography in the past, never before, apparently, has this idea been applied to x-ray pictures for the purpose of bringing out clearly the details of a film. It was my good fortune to discover a photographer, by the name of Roy Donaldson, who had applied this idea in a practical way to x-ray films. Recognizing the possibilities of its application to better photography in producing pictures of x-ray films, we proceeded with experiments in order to develop the technic of this improved process of printing until it attained the present stage.

The finished picture is produced by printing simultaneously through two films —the original x-ray negative film and a positive film produced therefrom—with the two films slightly off register to assist in the ultimate stereoscopic effect. The technic consists in first printing a positive film from the original negative. The two films are then placed together and slightly offset, and the finished print is made therefrom.

The results achieved naturally depend on the knowledge, skill and technic of the photographer. Of course the timing of the various exposures must be experimented with, and the degree and manner of offsetting the two films and the grade of printing paper and raw film used play an important part in the production of satisfactory and accurate results.

The following illustrations demonstrate the effect produced by this method of printing, as compared with the method of simply making positive prints.

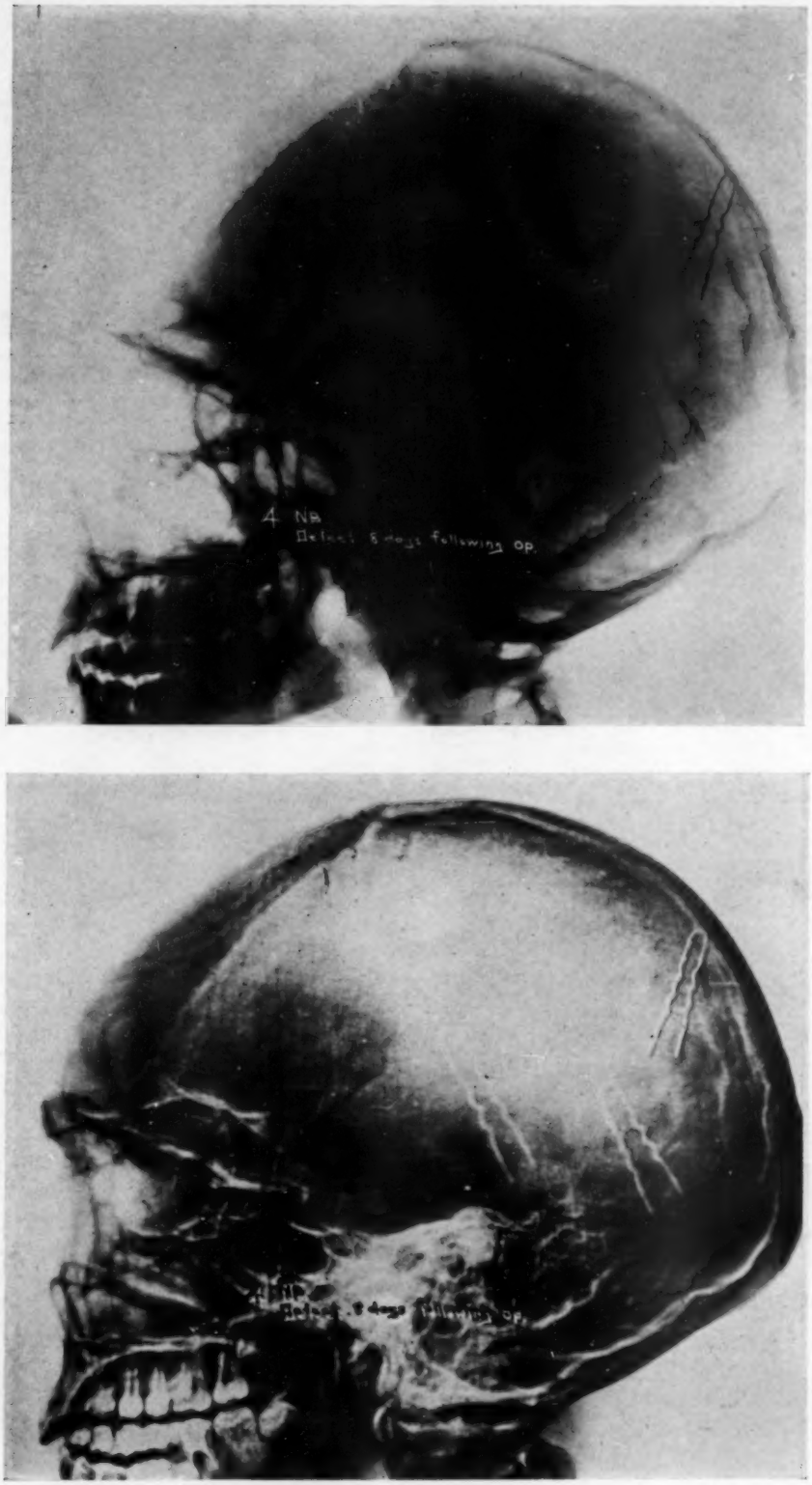

Fig. 1.—Old and new methods of printing x-ray films, showing stereoscopic effect of the new method of printing from both positive and negative films.

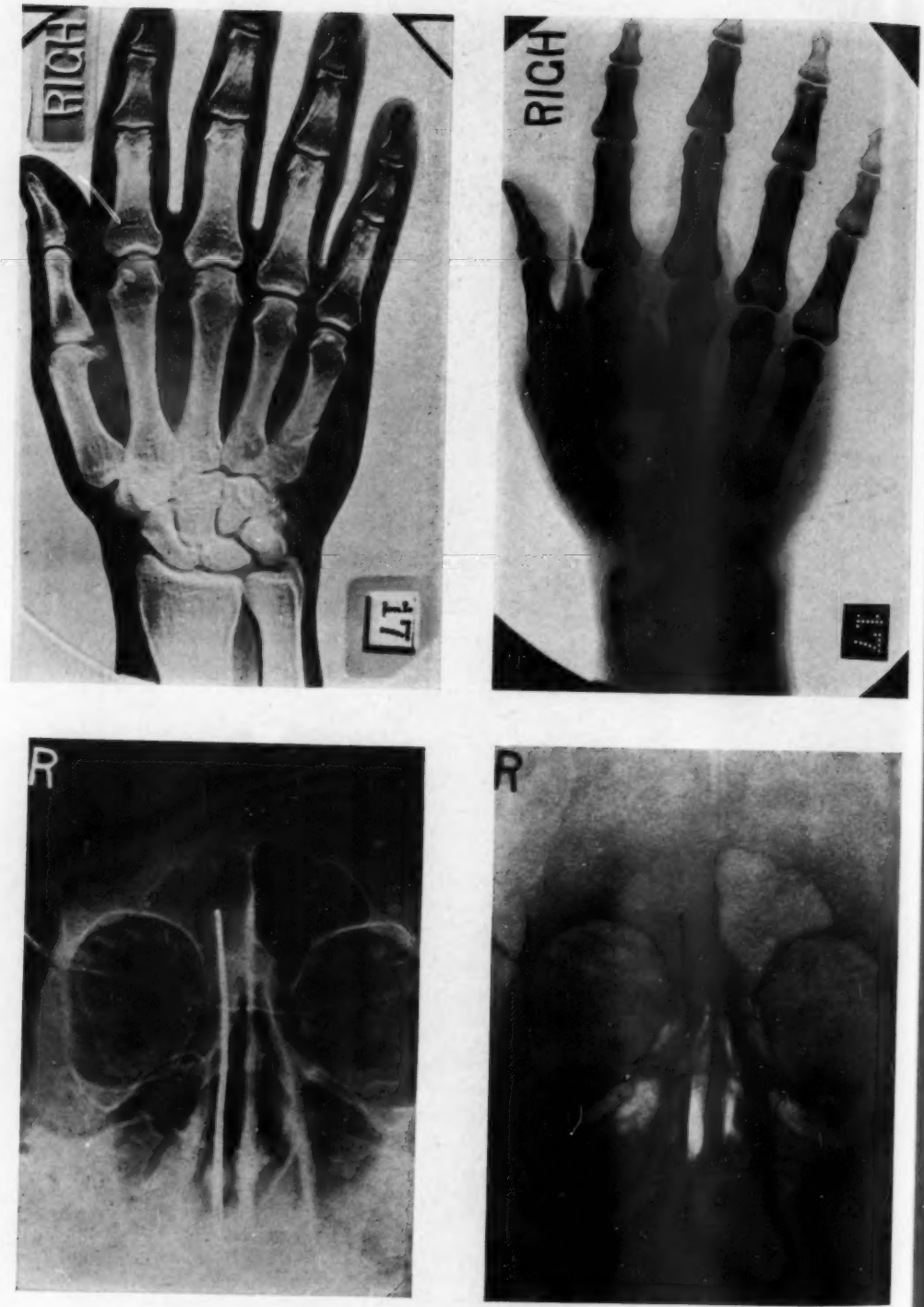

Fig. 2.—Same as figure 1.

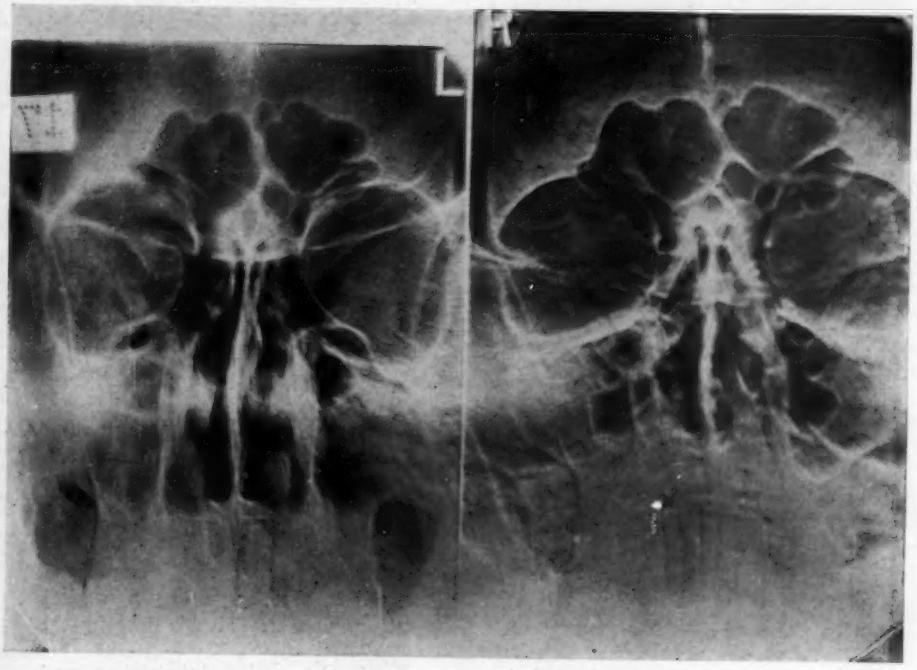

Fig. 3.—Same as figure 1.

THE LARYNGOSTROBOSCOPE

LYLE S. POWELL, M.D., LAWRENCE, KAN.

The stroboscopic principle was first used for the examination of the vibrations of a taut string making a musical note. As these vibrations are too rapid for visual perception it was necessary to find some means whereby a slow motion effect could be obtained. This was done by the use of interrupted light, usually with a rapidly revolving perforated disk. By this means a fleeting glimpse was obtained as each perforation in the disk came into view. This divided the cycles or phases of the vibrations in such a way that there was an apparent retarding of the movement, although a true picture was given in its complete cycle. In other words, a small bit of each phase is seen, which, coupled with the next succeeding glimpse in a later cycle, gradually builds up an apparently complete cycle or vibration from many actual vibrations.

The human vocal cords also vibrate too rapidly for perception. In examination with a laryngeal mirror the larynx may be seen to close on phonation and open on breathing, but the actual excursions of the vibrations themselves may not be seen or studied unless there is an apparent retarding of the rate of vibration. To have a thorough understanding of the function of the larynx it is important to study these vibrations, the methods of approximation of various parts of the cords and the portions of the cords used in making different tones and to discover and study the pathologic conditions that modify the motility of the larynx.

The instrument presented is the result of several years of experimentation and the clinical use of the stroboscopic principle in the examination of the larynx. Contrary to popular conception such an apparatus may be exceedingly simple and inexpensive and may be constructed by any one. The total cost of materials should not exceed $12.

The laryngostroboscope presented consists of a one-fourth horse-power variable field dental motor which may be purchased second hand at a low figure at any dental supply house. (Smaller motors have been found impracticable.) One end of the shaft of the motor is fitted with a collar, 2½ inches (6.27 cm.) in diameter, which slides over the shaft and is fixed with a set screw. The shaft of the collar is threaded in a direction opposite to that in which the motor turns. On these threads may be screwed another collar, likewise 2½ inches in diameter. Between these two collars the perforated disk is placed. The disk may be of any size and may have any number of perforations; it is recommended, however, as a result of many experiments, that the disk be 18 inches (45.72 cm.) in diameter and have twelve perforations, 1½ inches (3.77 cm.) long by ½ inch (1.27 cm.) wide, equidistant and placed with the long axis of the perforation parallel to the radius of the disk. It is also recommended that the disk be made of lightweight cardboard such as is ordinarily used for window display advertising.

A 500 watt electric light bulb is placed behind the perforations of the disk so that the light will shine through the perforations as the disk turns. A metal or glass tube, with a rubber tube attached, is fixed in position behind the perforations of the disk so that when one blows through the rubber tube the stream of air will strike the perforations of the rotating disk, thereby causing a musical note. The speed of the motor must be minutely adjustable. This is done by the

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Presented at the meeting of the American Academy of Ophthalmology and Otolaryngology, Boston, Sept. 18, 1933.

use of an ordinary continuously wound rheostat and by variation of the field of the motor, thereby obtaining the effect of two or more rheostats connected in a series. This may be made into a compact, simple, inexpensive single unit.

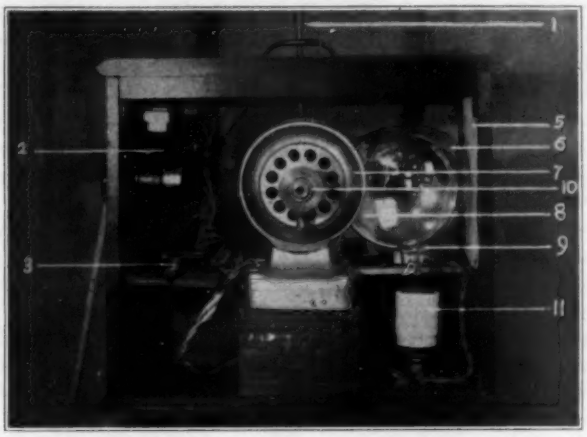

Fig. 1.—Laryngostroboscope with the front plate removed showing: *1,* lever for control of speed (by varying the field of the motor); *2,* rheostat wound continuously and in continuous contact, with the control knob extending outside the cabinet (this varies the speed by controlling the amount of current used); *3,* metal or glass tube fixed in position with a long rubber tube extension; *5,* asbestos lining of the cabinet in proximity to the light globe; *6,* 500 watt light globe; *7,* one-fourth horse-power variable field dental motor; *8,* concave silvered glass reflector fixed in position behind the light globe; *9,* light switch; *10,* removable supporting collars fitted over the shaft of the motor and fixed with a set screw; *11,* mogul socket for the 500 watt bulb.

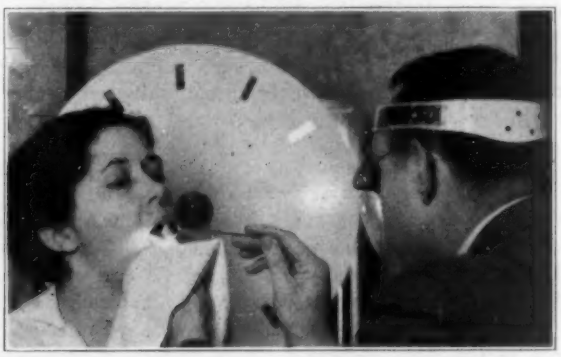

Fig. 2.—Showing the clinical use of the laryngostroboscope. The instrument is used as the source of light in making the usual laryngeal examination with a head mirror and a laryngeal hand mirror.

The instrument is used as the source of light in the ordinary examination of the larynx with a head mirror and laryngeal mirror. The patient to be exam-

ined is placed a little in front of and to one side of the apparatus, with the examiner in the usual position in front of the patient. The motor is started, and by blowing on the tube a note is found that is easily within the patient's range. The patient is asked to make this note and to remember the tone so as to be able to reproduce it when required. The motor is allowed to rotate at the same constant speed with which the first note was made. By examining the larynx of the patient when he produces this note, the cords will be seen to vibrate slowly. If they are not seen to do so at once it will be necessary to change the speed of the motor a slight amount in order that the phases or cycles will not dampen each other. By varying the speed and by having the patient make the original tone the cords will be seen to vibrate at varying speeds, from a very slow rate to a rapidity approximating that with no interruptions of light whatever.

The approximating surfaces of the cords, the relative rate of vibration of the two cords, the parts of the cords most used and many other phases of the larynx and its function may thus be studied with a surprising degree of accuracy. By increasing or decreasing the speed of the motor and thus the tone produced by the stream of air blown through the perforations the patient's tone may be moved up and down the scale as required. As frequently happens with singers and public speakers, a particular part of the scale may be the only source of difficulty. This faulty island in the range may be thoroughly studied and compared with higher or lower notes with which the patient has no difficulty.

The laryngostroboscope is not a therapeutic instrument in any sense of the word. It is, however, a considerable addition to the armamentarium of any laryngologist desiring to study, diagnose and treat conditions having to do with the motility of the larynx.

833 Massachusetts Street.

QUINSY IN A YOUNG INFANT

HARRY L. BERMAN, M.D., NEW HAVEN, CONN.

Peritonsillar abscess in children is rare, and in infancy it is particularly rare, so that its occurrence in an infant 9 weeks of age is deemed worthy of report. In a search of the literature no record has been found of typical quinsy in so young an infant.

REPORT OF CASE

I. B., born on July 6, was taken ill on September 11, with fretfulness, fever and a swelling at the angle of the jaw on the right side. The symptoms continued, and the swelling at the angle of the jaw increased. There was no respiratory distress or dysphagia. The patient was first seen on September 14 by Dr. Joseph Weiner, who made a diagnosis of peritonsillar abscess and referred the case to me. An examination of the throat showed a typical picture of peritonsillar abscess on the right side. Inspection and palpation showed no evidence of a retropharyngeal abscess. The patient was admitted to the New Haven Hospital on September 15. On admission the temperature was 38.2 C. (100.7 F). Examination showed a well

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Read at a meeting of the Eye, Ear, Nose and Throat Section of the Connecticut Medical Society, Nov. 3, 1927.

developed, well nourished, active and vigorous infant. There was no apparent respiratory distress or dysphagia. The skin was in good condition. The head was not retracted and the fontanels were level. There was no aural or nasal discharge and the ears were normal. In the throat the anterior pillar and soft palate on the right side were bulging and fiery red. There was a firm, non-fluctuating nodule the size of an English walnut at the angle of the jaw. The heart, lungs and abdomen were normal.

On September 15 an incision was made through the anterior pillar and soft palate on the right side. No anesthesia was used. Considerable pus was evacuated; suction was employed. The temperature was normal the next day and recovery was uneventful.

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Progress in Otolaryngology

A Summary of the Bibliographic Material Available in the Field of Otolaryngology

CHRONIC PROGRESSIVE DEAFNESS, INCLUDING OTOSCLEROSIS AND DISEASES OF THE INNER EAR

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During the past year, Bast [1] presented a complete account of the development of the fissula ante fenestram, a structure of interest in that in this area the bony changes known as otosclerosis most frequently occur. He traces its growth from its first appearance in the embryo to its full development. Fifty-five human fetuses were studied. The youngest specimen to show a fissula was a fetus of 43 mm. crown-rump length, or one approximately 8 weeks old. In this embryo the otic capusle was still mainly precartilage, and the scala tympani and scala vestibuli were just appearing on the inner side of the stapes. The fissula was represented by a small evagination of loose tissue anterior to the foot plate of the stapes. A little later it was well marked at the vestibular end, while closer to the middle ear it was represented by a mere strand of spindle cells. In a 14 week old embryo the fissula was more marked and was filled with loose connective tissue. By this time it extended to the annular ligament and through to the middle ear in front of it. A blood vessel was seen entering the fissula from the middle ear and causing absorption of the cartilage in that area.

At about 4 months, the capsule had reached its full growth, and the fissula had also attained its maximum size. Some ossification was taking place, and there was considerable activity of the blood vessels. At 24 weeks, the fissula was completely surrounded by bone. A little later the connective tissue at its edges became transformed into cartilage, which persisted throughout life. The posterior end of the middle part of the fissula was seen in contact with the annular ligament, the fibers of which ran into the fissula. The area round the fissula was one of the last parts of the labyrinthine capsule to ossify. This occurred at 22 weeks.

1. Bast, T. H.: Development of the Otic Capsule: II. The Origin, Development and Significance of the Fissula Ante Fenestram and Its Relation to Otosclerotic Foci, Arch. Otolaryng. **18**:1 (July) 1933.

As yet no very satisfactory explanation for the existence of the fissula ante fenestram has been suggested. Several theories have been advanced, but they have not gained general acceptance.

Bast reconstructed a model of an otosclerotic bone showing the focus surrounding the fissula but not growing from it.

Guggenheim [2] continued his studies on the cause of otosclerosis. He traces the evolution of the ear from the lowest vertebrates upward in the scale. In the lowest form of vertebrate life (Myxine glutinosa, hagfish) there are only two semicircular canals, and there is no evidence of an oval or round window. In the lamprey, a sacculus is found. The bony fish have all three semicircular canals, a lagena cochleae and three additional nerve endings. In ganoids there is still no sign of windows. In the genuine bony fish (teleosteans), such as the carp and catfish, there are three ossicles articulating with the first three vertebrae. Here also is the first appearance of a vestibular window. In the herring, the labyrinths communicate with each other, and there is also a forerunner of the window. In the pike, the labyrinthine capsule is formed from several bones joined together by cartilage. Guggenheim suggests that these may possibly be the prototypes of the partitions of cartilage in which otosclerosis begins.

In the shark, there is a protrusion of one angle of the utricle which extends to the oval window, while in the ray there is a similar canal which extends to the oval window and through it.

Guggenheim [3] writes:

> Summarizing our data: In the spine shark is a utricular evagination (accessory endolymph channel) passing as far as the outer capsule wall. In the thorn ray a similar utricular diverticulum passes to and through the outer capsule wall. In the frog a passageway, no longer connected with the utriculus, passes from the perilymph chambers, through the outer capsule wall between fovea fenestrae ovalis and footplate of columella, to end as a blind sac in the tympanum. In the hyena and antelope there is an evagination in the outer wall of the vestibulum. In the antelope a diverticulum of the sacculus protrudes into the evagination. In children, Ibsen found a capsular evagination posterior to the stapes in one out of three new-born children. In this evagination was a diverticulum. Siebenmann finding the evaginations concluded that the fissula ante fenestram in man is a rudiment of the evagination found in the hyena and antelope.

The foregoing data are advanced in support of the theory of regression, i .e., that the fissula ante fenestram represents a vestigial structure and is therefore liable to regressive degenerative changes resulting in otosclerosis.

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2. Guggenheim, L. K.: The Cause of Otosclerosis: Phylogenesis of the Ear, Ann. Otol., Rhin. & Laryng. **42**:251 (March) 1933.

3. Guggenheim, L. K.: The Cause of Otosclerosis: Ontogenesis of the Aural Capsule, Ann. Otol., Rhin. & Laryng. **42**:1171 (Dec.) 1933.

In the amphibia, the stapedial foot plate appears for the first time in Proteus anguinus. A rudimentary cochlea with a membrana tectoria is also present, but there is no round window. In the frog there is a true round window as well as a protrusion from the labyrinth through the wall which ends blindly in the middle ear.

Among the reptiles, the snake has an ossicle attached to the jaw, and in some lizards there is no oval window and the columella is attached to the periosteum.

In a second paper on the ontogenesis of the labyrinthine capsule, Guggenheim [4] follows the development of the capsule from the stage of mere condensation of the mesenchyme in the 9 mm. embryo through the precartilage stage at 14 mm. to its partial transition to cartilage at from 25 to 30 mm. At 30 mm. the perilymphatic spaces begin to appear, and at 40 mm. the scalae are well developed. At 16 weeks, the scalae attain their adult size and form. Growth of the cartilage model occurs by a change at the periphery of the precartilage, while simultaneously there is a dedifferentiation of the cartilage cells bordering the interior into precartilage again and finally into reticulum. This reticulum becomes looser in texture, till finally large spaces occur which form the rudiment of the future perilymphatic spaces.

Guggenheim's [3] account of the further development of the capsule is based largely on the work of Bast. Ossification begins at about the sixteenth week with a center on the outer surface of the capsule at the beginning of the first turn of the cochlea and adjoining the round window. The second center of ossification lies on the outer part of the capsule on the inferomedial side of the ampulla of the posterior canal. The third center begins above the entrance of the nerves to the external and superior semicircular canals. The fourth center is superolateral to the round window. At 18 weeks, eight other centers are present. The area around the foot plate of the stapes is the last to ossify.

In considering the much disputed question of spontaneous fractures of the labyrinth, Kelemen [5] studied 14 petrous bones from persons who had died from fracture of the base of the skull. Many types of fractures were represented. The only bones of interest here are 5 in which the fracture extended from the round window to the ampulla of the superior semicircular canal. The fractures corresponded with those described by O. Mayer, about which there has been so much controversy. In Kelemen's series they had no relation to the other fractures caused by undoubted trauma. The fractures in question

4. Guggenheim, L. K.: The Cause of Otosclerosis: Ontogenesis of the Aural Capsule, Ann. Otol., Rhin. & Laryng. **42**:596 (June) 1933.

5. Kelemen, G.: Ueber die Fissuren im knöchernen Innenohr, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **137**:36, 1933.

ran across an area in which the bone fibers were all more or less parallel, and the fissures ran squarely across them. The absence of criss-cross fibers made this an area of less resistance and more prone to fracture.

The periosteum and endosteum at either end were not torn. In certain places vessels traversed the fracture without being ruptured. In some instances the cleft contained granular detritus, and in others it was empty. The author advances the rather unconvincing theory that the fractures were caused by change of pressure of the endolymph or of the air in the middle ear and had nothing to do with repeated slight traumas. He apparently assumed that these clefts occurred *intra vitam*. He does not make any reference to Wittmaack's theory that they are probably caused post mortem by the strains set up by the various fixing decalcifying and dehydrating fluids.

Steinberg [6] studied the cartilage spaces in the labyrinthine capsules. They were first called interglobular spaces by Gegenbaur. Ossification of the cartilage of the labyrinthine capsule takes place in the same way as in the long bones up to a certain point. The remaining cartilage cells in the long bones disappear, but in the labyrinth many persist throughout life. This study was undertaken to see if there was any definite arrangement in the number and situation of the interglobular spaces. Thirty series of horizontal sections and 10 of vertical sections were studied. In general, the cartilage cells are most common in the lowest part of the labyrinthine capsule. In certain areas, e. g., the top of the two vertical canals, no cartilage cells occur, as in this location there is little endochondral bone. The cartilage cells apparently have a definite arrangement. They are most common in the angles between the canals, but there are none in the region of the former fossa subarcuata. There are more at the lateral end of the superior semicircular canal than at the medial end, and in the posterior canal there are more at its lower end. In all three canals they are most numerous round the ampullae. The tip of the cochlea has very few, there being only a thin layer, which is often absent. There are many interglobular spaces arranged radially at the base of the cochlea. Some cartilage cells are present in the partition between the lower and the middle coils of the cochlea, this being the only partition that was originally cartilaginous, and many cartilage cells are found near the oval and round windows and also inferiorly between the cochlea and the internal auditory meatus. There is great variation in the shape of the interglobular spaces. When the endochondral bone consists of only a thin layer, the spaces tend to be parallel to the surface, but when

6. Steinberg, Lotte: Ueber die Verteilung und Lage der knorpelhaltigen Interglobularräume in der menschlichen Labyrinthkapsel, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **135**:187, 1933.

the bone is thick they are mostly radial. There appears to be no regular arrangement according to age and sex, and there is a great deal of variation.

Weber [7] discusses the well known blue mantles of Manasse in otosclerosis. They consist of areas surrounding the vessels in the endochondral bone which stain blue with hematoxylin and eosin, while the rest of the bone stains pink. He studied 51 human otosclerotic temporal bones in which there was no sign of Paget's disease. These mantles have aroused a good deal of controversy as to whether they were old changed bone or new bone formation. The bone cells in the mantles are large and numerous and resemble the cells of primitive bone tissue. The matrix shows a marked affinity for hematoxylin and is granular or crumbly in texture. The fibrils in these areas run in a criss-cross way unlike those in the surrounding bone, and there are fewer of them. They can be demonstrated by polarized light or by staining with the Bielschowsky-Maresch silver method. In this way the fibers are seen to end abruptly at the edge of the mantles as if they were cut off. Howship's lacunae can be seen at the edges of the mantles with bays into the normal bone, indicating giant cell absorption. Weber uses a "two-picture" method. A given section is stained with hematoxylin and eosin and is photographed. The identical area is then decolorized and photographed with polarized light. Weber believes that the blue mantles are new poorly formed bone replacing normal bone. They occur in and around otosclerotic foci. He traces in serial sections some of the mantles in the surrounding bone into the otosclerotic focus.

Weber found blue mantles in 27 per cent of 51 cases of otosclerosis. In the remaining 72 per cent, he saw other types which he named mixed and red mantles. The mixed mantles are composed of lamellar bone surrounded by a layer of blue mantle bone. The red mantles are composed of pure lamellar bone. In these also there had been absorption before their complete formation, as is shown by the interruption of the lamellar fibrils and the presence of Howship's lacunae.

Weber states that the tissue of the blue mantles is identical with that of the otosclerotic focus, and that they represent merely an early stage of otosclerosis. He did not find any mantles in 20 normal temporal bones. He believes that there is a direct genetic connection between otosclerosis and other general diseases of the bone, such as Paget's and Recklinghausen's diseases and osteogenesis imperfecta.

Three investigators have been carrying out studies on the minute structure of the labyrinthine capsule in certain lower animals.

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7. Weber, M. H.: Blue Mantles in Otosclerosis: A Contribution to the Pathology of the Labyrinthine Capsule, Ann. Otol., Rhin. & Laryng. 42:438 (June) 1933.

Hafner [8] studied the labyrinth in some of the rodents, namely, the rabbit, guinea-pig, mouse and rat. In the rabbit the labyrinth lies inside the petrous bone as in man, but the three layers are not so distinct. The endochondral bone is very compact, with hardly any marrow spaces. Cartilage cells are scattered throughout and color light blue with hematoxylin and eosin. There are no cement lines and the fibers of the bone form a dense network running in all directions. The blood vessels of the endochondral bone send twigs to supply the endosteal bone. The periosteal layer completely surrounds the endochondral bone. The bone fibrils for the most part run parallel to the axis of the petrous bone. In the semicircular canals there are no gaps in the endosteal layer as there are in man.

Ossification occurs relatively late in development. At birth there is only one center of ossification at the base of the cochlea, while the rest of the capsule is pure cartilage. There is also some endosteal and periosteal ossification. The endochondral ossification spreads rapidly throughout the capsule forming spongiosa, which is later transformed into compact bone.

The guinea-pig is peculiar in that the cochlea lies almost entirely within the middle ear cavity and is attached to the rest of the petrous bone only by a small bridge at its base and inner side. The capsule of the cochlea is very thin, and the three layers can hardly be distinguished except by polarized light. Cartilage cells are fairly numerous. The bone on the whole is rather similar to the human labyrinth.

In the mouse the labyrinth does not lie within the petrous bone. The cochlea and semicircular canals lie free in the middle ear cavity and are attached to the rest of the bone only by small bands. Ossification is almost finished at birth in the region of the base of the cochlea and part of the semicircular canals. The tip of the cochlea and part of the canals are still purely cartilaginous. The endochondral capsule of the cochlea shows a network of cartilage throughout, and this is particularly well seen at the apex. Even in the adult cochlea, some cartilage cells with nuclei can still be found in this region. Endosteal bone is almost entirely absent in the cochlea. The periosteal layer is thicker than the endosteal layer, except at the apex of the cochlea, where it is extremely thin. Its fibrils run mostly in one direction, and there are not many marrow spaces. The capsule enclosing the semicircular canals is similar in general character to the rest of the capsule. There are no large air spaces as in the rabbit and guinea-pig.

The labyrinth of the rat is very similar to that of the mouse, but the marrow spaces are more numerous and show some transformation

8. Hafner, K.: Die knöcherne Labyrinthkapsel der Nagetiere (Kaninchen, Meerschweinchen, Maus und Ratte), Arch. f. Ohren-, Nasen- u. Kehlkopfh. **137**: 282, 1933.

during life. The endochondral layer is absent here and there as in the mouse, and the periosteal layer takes its place.

Wilhelm [9] studied the structure of the labyrinthine capsule in the carnivora, namely, in the dog and cat of various ages. In the dog of 8 days the ossification of the cochlea is practically complete, but the semicircular canals are not quite ossified. The head of the stapes is also still cartilaginous. In contradistinction to man and apes, the cartilage cells and globuli ossei are sharply defined from the rest of the bone by lines (*Ansatzlinien*). This is also seen in the adult dog. Cement lines, on the other hand, are sparse. In general, the labyrinth of the dog closely resembles that of man.

In a cat of 3 weeks, ossification is practically completed, and no masses of cartilage are left. There appear to be two kinds of bone mixed together. The fibrils are arranged irregularly in one kind of bone just as in man, dogs and apes. In the other type of bone the fibrils are arranged like lamellae round the blood vessels in concentric rings. It is not true lamellar bone, as silvered and polarized specimens show that the arrangement of the fibrils is different. Apparently the process is a little more advanced in the cat than in man. Different areas are divided by cement lines, indicating absorption. The substance in the resorption spaces is hard to identify, as there are no fibrils and the matrix does not stain well. In the cat there are also irregular areas showing partial metaplasia into a structureless bone which is found around the vessels. This metaplastic bone is surrounded by the ordinary fibrous bone of the labyrinthine capsule. It is found in cats of all ages.

A similar study was made by Haag [10] on the labyrinths of two types of monkeys, namely, Macacus rhesus and Cynocephalus hamadryas. He found that the structure of the bone of the labyrinthine capsule is substantially the same as in man with similar cartilage-containing interglobular spaces. The distribution of the cartilage islets and arrangement of the bone fibers closely resemble the characteristics of the human capsule. The petrous bone in both types of monkey is much less massive and has a much smaller periosteal layer than in man. The endosteal layer is very thin and is absent in spots, so that cartilage cells sometimes lie in contact with the lumen.

Tobeck [11] carried out some experimental work on 4 rabbits. He injected 2 cc. of viosterol daily for two months, producing extensive decalcification of the skeleton. The bones became very brittle and

9. Wilhelm, E.: Ueber den feineren Bau der knöchernen Labyrinthkapsel von Hund und Katze, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **136**:24, 1933.

10. Haag, E.: Ueber den Bau der Labyrinthkapsel einiger Affenarten, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **136**:14, 1933.

11. Tobeck, A.: Ueber Veränderungen im knöchernen Labyrinth von Kaninchen durch Vigantolüberdosierung, Ztschr. f. Hals-, Nasen- u. Ohrenh. **32**:550, 1933.

showed under the microscope the typical picture of osteodystrophia fibrosa. The labyrinths were affected in the same way and showed large cellular marrow spaces containing osteoclasts. There was formation of osteoid tissue with absorption round the vessels.

A series of 6 cases of osteitis deformans (Paget) is reported by Hürter.[12] All 6 cases were discovered in the course of examination for other conditions. The disease was confined mostly to the skull and extremities. Five of the 6 patients had some impairment of hearing, mostly of the inner ear type. Osteitis deformans is generally regarded as a form of osteodystrophia fibrosa.

Nager and Meyer [13] again call attention to the similarity between otosclerosis, osteitis fibrosa and osteitis deformans. It is not possible to make a differential diagnosis on the basis of changes in the petrous bone alone. It is necessary to examine the rest of the skeleton as well. Otosclerosis is not an isolated phenomenon in pathologic conditions of the bone but falls into line with the other two conditions. Osteitis fibrosa (von Recklinghausen) is due to general decalcification of the skeleton from tumors of the parathyroid gland, and it can be improved by removal of the tumor. The cause of the other two conditions is not yet known.

Similar osseous pictures can be produced experimentally by (1) feeding a diet poor in calcium with no vitamin D, (2) by injection of minced human parathyroid gland, (3) by chronic lead poisoning, (4) by injection of parathyroid hormone (here the labyrinthine capsule is unchanged),[14] (5) by the formation of a fistula from the biliary tract to the ureter (enlargement of the parathyroid glands resulting) and (6) by long-standing acidosis.

In a paper on otosclerosis associated with hyperfunction of the lymphatic system, Döderlein [15] points out the difficulty in recognizing early otosclerosis. Obviously by the time the symptoms appear the disease has been in progress for a considerable time, and in all probability the original cause no longer exists. He looks on the process as a local decalcification followed by healing. Great variation in the blood calcium has been reported by different observers. Almost the only chance of making a reliable diagnosis is to examine the patients during

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12. Hürter, H.: Zur Klinik und Symptomatologie der Ostitis deformans Paget, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **137**:14, 1933.

13. Nager, F. R., and Meyer, M.: Die Stellung der Otosklerose in der heutigen Knochenpathologie, Ztschr. f. Hals-, Nasen- u. Ohrenh. **31**:417, 1932.

14. Galle, C. K., and Jaffe, H. L.: The Labyrinthine Capsule in Guinea-Pigs with Hyperparathyroidism, Arch. Otolaryng. **14**:815 (Dec.) 1931.

15. Döderlein, W.: Otosklerose bei Erkrankungen mit Hyperfunktion des lymphatischen Systems, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **134**:24, 1933.

a flare-up of the process such as occurs during pregnancy, but the practical difficulties are very great.

Out of a collection of 200 petrous bones, Döderlein picked a few in which the otosclerotic process seemed to be in an early stage or had some new foci. Five specimens were selected with early (*Abbau*) changes, 4 from women and 1 from a man. None of the changes was found in the position of predilection, but all were in the endochondral labyrinth near the vestibule or canals. According to Döderlein, this localization is characteristic of the otosclerosis which comes on late in life. He quotes Lange, who calls such cases florid otosclerosis and thinks that the cause is probably present at death. Three of the 5 patients had died of lymphatic leukemia and 1 of extensive tuberculosis, and 1 had died of pneumonia but had had tuberculous pleurisy. All these conditions were associated with overactivity of the lymphatic system. Döderlein quotes Nietschke as stating that rickets is due to an overactivity of the lymphatic system, and he also refers to Wittmaack's work and suggests the possibility of a combination of venous engorgement and lymphatic hyperfunction causing otosclerosis.

In a fairly long paper, Breitmann [16] discusses the question of an endocrine disturbance as the basis for otosclerosis. When there are endocrine disturbances associated with otosclerosis, the disturbances probably have the same origin as the otosclerosis, namely, a degenerative state. They are not necessarily the cause of the otosclerosis, but are merely another result of the same underlying condition. Breitmann found in a large series of experiments that the blood calcium is either normal or increased. He has been unable to find any sign of parathyroid insufficiency. He obtained normal or increased cholesterol figures in the serum, the latter principally in old people. In a whole series there was a high blood sugar curve both before and after a test meal. Breitmann agrees with a statement of Leicher's to the effect that the belief of several authors that organic extracts of endocrine glands influence otosclerosis favorably indicates nothing regarding the causal relationship of these hormones to otosclerosis, since the improvement in hearing and tinnitus can occur through nonspecific effects on the blood pressure, distribution of blood and swelling or constriction of the tissues. According to Breitmann, the idea of an endocrine disturbance as the cause of otosclerosis rests on a very superficial diagnosis in most cases. In few instances has a thorough study of the endocrine glands been made. In most cases there is diminished activity of the genital glands. Breitmann has seen many cases of the interrenal-genital syndrome with hirsutism, especially of the male type, in women. This is important only as indicating a general degenerative state.

16. Breitmann, M.: Ueber die endokrinen Grundlagen der Otosklerose, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **136**:117, 1933.

Rosenfeld [17] treated otosclerosis for two years with epinephrine combined with calcium and cod liver oil. He professes to have obtained considerable improvement in hearing and tinnitus in all early cases and in half of the late cases.

He believes that otosclerosis is allied to rickets and osteomalacia, and that the latter is much commoner than is generally supposed, especially in its latent or abortive form. He has treated many persons suffering from osteomalacia with epinephrine, which is supposed to stimulate the deposition of calcium in diseased bone. He warns against using too much epinephrine, as tremors, palpitation and dizziness can easily be produced. His method is to give an injection once a week of 0.1 mg. of epinephrine and every third day 1 teaspoonful of calcium gluconate and 1 tablespoonful of cod liver oil. This is continued for six weeks, after which the epinephrine is stopped, but the calcium and oil are continued.

Schmidt [18] contributes an interesting study of the rôle which pregnancy plays in otosclerosis. The paper is based on 106 cases of otosclerosis, 79 of which were in women and 27 in men. Of the 79 women, 24 were unmarried and 55 married. Only 49 had been pregnant, and 24 of these had noticed no change in hearing during either the pregnancy or the puerperium. Twenty-five (50 per cent) had a striking loss of hearing. The diminution of hearing was noted during the first pregnancy in 19 women, during the second in 4, during the third in 1, and during the fourth in 1. One patient was worse after abortion.

Many different conditions seemed to be capable of aggravating the deafness. In her material Schmidt noted trauma, prolonged anxiety or excitement, menstruation, appendicitis and various other illnesses. All those patients who gave a history of increased deafness from some of the causes mentioned had also been worse after pregnancy. It seemed to be not gravidity especially but any severe bodily disturbance which has a tendency to make the hearing worse. In this connection it must be remembered that abortion constitutes a severe strain on the system. Definite indications for the induction of abortion in otosclerosis do not exist, except in some patients with pronounced hereditary otosclerosis or with noises in the head of such severity that they are distracted by them. From a eugenic point of view, the question of abortion is not yet clear, as many persons suffering from deafness are able to fill a useful niche in society and are otherwise normal or even supernormal. As an example of the latter, Beethoven at once comes to mind.

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17. Rosenfeld, W.: Neue Richtlinien im Kampfe gegen die Otosklerose, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **134**:33, 1933.

18. Schmidt, E.: Erblichkeit und Gravidität bei der Otosklerose, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **136**:188, 1933.

With regard to heredity, a familial history of otosclerosis was obtained in 57 of 106 cases of otosclerosis. The diagnosis of hereditary otosclerosis was a little doubtful in 10 cases, as senile deafness could not be excluded. There was no known otosclerotic heredity in 49 cases. Schmidt added 3 fairly comprehensive family trees showing otosclerosis.

HEREDITY IN OTOSCLEROSIS

Davenport, Milles and Frink [19] present a monumental work on the genetics of otosclerosis. This is the most exhaustive scientific study of the subject which has yet appeared. In addition to an analytic study of previously published genealogies, Davenport and his co-workers studied considerable fresh data and applied to them ten different genetic hypotheses. Of these, only one will harmonize fairly closely with the facts. The authors state:

> Otosclerosis develops under external conditions that favor it whenever the patient has a constitution that combines two dominant factors, as follows: a factor X, which lies in the sex chromosome, and a factor, A, which lies in one of the autosomes.

In the human species the male has only one sex chromosome while the female has two.

On the basis of the foregoing hypothesis, the authors conclude:

> The female zygote has the same chance as the male of getting an X-chromosome from the egg. About half of the female otosclerotics have received their affected X-chromosome from the egg; the other half have received an affected X-chromosome from the sperm. Hence, we should expect twice as many zygotes carrying an affected X-chromosome in the females as in the males—and this agrees closely with observation.

TUMORS OF THE ACOUSTIC NERVE AND OTOSCLEROSIS

Gray [20] reports the clinical and pathologic changes in 2 cases of tumor of the acoustic nerve. Both were cases of bilateral, multiple neurofibromatosis (von Recklinghausen), and in both there were bilateral typical otosclerotic areas in the labyrinthine capsule. Gray had previously reported a similar case. All 3 cases were alike, and the spiral ganglion was affected in all. In spite of marked degeneration of the ganglion in 2 of the cases, the organ of Corti was normal.

In 1932 the author advanced the view that otosclerosis was the result of a defect in the reflex nerve arc on which the nutrition of the organ of hearing depends. Changes in the bone and cochlear nerve

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19. Davenport, C. B.; Milles, B. L., and Frink, L. B.: The Genetic Factor in Otosclerosis, Arch. Otolaryng. **17**:135 (Feb.); 340 (March); 503 (April) 1933.

20. Gray, A. A.: Two Cases of Acusticus Tumors, with Clinical and Pathological Reports, J. Laryng. & Otol. **48**:535 (Aug.) 1933.

are two of the effects which may occur when that reflex arc fails to function. The foregoing 3 cases support this view.

Wirth and Curth [21] record in graphic form the course of otosclerosis, which, as far as I am aware, has not been done before. The late Professor Kümmel of Heidelberg had the opportunity of following a large number of patients with otosclerosis for many years and tested their hearing from time to time. The authors made use of the notes on 250 patients seen and examined personally by Professor Kümmel. They show in graphic form the progress of the condition as revealed by periodic hearing tests. Many of the graphs show striking differences between the two ears and also periods of marked improvement which, however, never lasted long. Most of them show a gradual deterioration of hearing. A composite graph of all the patients shows a marked decrease in hearing between the ages of 40 and 50 and a less rapid downward curve to the age of 60. The hearing as tested with the monochord shows a fairly steady decrease between the ages of 20 and 40. The majority of the patients came about the age of 20 for their first examination.

Shambaugh and his co-workers [22] conducted a survey of 165 adults with deafness severe enough to be a handicap. The data were collected from the Chicago League for the Hard of Hearing, the Washington League and Shambaugh's private practice. Thirty patients were afflicted with primary nerve deafness, caused by a congenital defect in 2, by toxic neuritis from an acute infectious disease in 5, by a noisy occupation in 2 and by senile changes in 7. Syphilis was the probable cause in 1 case. In 12 patients with primary nerve deafness the cause was unknown, but in 6 of these the labyrinthine type of otosclerosis was suspected. Twenty patients suffered from a tubotympanic middle ear deafness. One hundred and fifteen patients had conditions diagnosed as otosclerosis with primary fixation of the stapes.

It will be noted that the proportion of otosclerosis is high. Positive evidence of familial deafness was obtained in 73 per cent of the persons from the Washington League. The high proportion of positive familial histories is attributed to the fact that the patients were warned beforehand to make inquiries. In Chicago a positive familial history was obtained in only 58 per cent.

The number of cases of otosclerosis with changes in the drum membranes was no larger than in a similar number of persons with

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21. Wirth, E., and Curth, H.: Kurvenmässige Darstellungen des Otoskleroseverlaufes, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **136**:202, 1933.

22. Shambaugh, G. E.; Wallner, L. J.; Greene, L. D., and Shambaugh, G. E., Jr.: Severe Deafness in Adults: A Clinical Study, Arch. Otolaryng. **18**:430 (Oct.) 1933.

normal hearing, and consisted for the most part of residues of tubotympanic catarrh or suppuration in childhood which had worn off long before the onset of the progressive deafness. Deafness of combined etiology was found in only 5 of the 165 cases. There were only 2 cases of sinusitis, and the general health of the patients was good.

According to the authors:

> Our conclusions are that only 12 per cent of severe adult deafness is due to middle ear disease beginning in childhood and is in any way preventable by examination of school children. Severe deafness in adults profound enough to constitute a handicap is due to otosclerosis with ankylosis of the stapes in the majority of instances (70 per cent) and is neither preventable nor amenable to treatment in the present state of knowledge.

DEAFNESS IN IDENTICAL TWINS

G. Shambaugh and G. Shambaugh, Jr.,[23] and Rodin [24] report cases of identical twins with identical deafness. Rodin's patients were two girls of 15 who had had scarlet fever at 6 but without otitis. The hearing became gradually worse after the illness. The patients were otherwise healthy. There was no familial history of deafness. Functional tests revealed an identical defect with the clinical characteristics of otosclerosis.

One of the cases reported by the Shambaughs was in a pair of identical twins with no familial history of deafness. The twins were women of 31 whose deafness began at the age of 17 and progressed slowly. There was no tinnitus or paracusis. Funtional tests showed primary nerve deafness. The hearing curve was approximately the same for both twins.

The second pair of twins were men of 69, who presented a strong familial history of deafness. The deafness came on about the age of 60. There had been no previous aural trouble. Paracusis was absent. The tests showed primary nerve deafness, but there was a possibility of otosclerosis as the audiograms showed a depression in the middle tone range.

Shambaugh states that it is obvious that heredity plays an important part in cases of this sort. It is possibly the most important factor in all cases of progressive deafness. Hereditary influence cannot be ruled out without consideration even when there is no familial history, as the tendency may be present in latent form and become evident only when two persons with the same latent defect mate and have offspring.

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23. Shambaugh, G. E., Jr., and Shambaugh, G. E.: Progressive Deafness Occurring in Identical Twins: With a Discussion of the Factors of Heredity in the Etiology of Deafness, Arch. Otolaryng. **17**:171 (Feb.) 1933.

24. Rodin, F. H.: Identical Hearing Defect in Identical Twins, Arch. Otolaryng. **17**:179 (Feb.) 1933.

Guggenheim [25] gives a preliminary report of a case of otosclerosis in a 7 month fetus, which so far is the earliest case on record.

Wilson and Anson [26] describe the histologic picture of a man with otosclerosis. The lesion was confined to the region of the anterior edge of the oval window. There was no ankylosis of the stapes. Two other small foci were also present. The main focus was crescentic and showed the typical large spaces containing thin-walled vessels in a thin reticulum with few fat cells. The bone consisted of lamellar systems around the vessels. The lamellae in places were continuous with the lamellae of the surrounding bone. The blood vessels of the focus were in the main part derived from the periosteum, but in the tips of the crescentic parts they were from the surrounding haversian system. Of the twenty-six vessels which entered or left these tips, twenty were from the deep surface of the focus and only six from the periosteum. Of the twenty-four which supplied the main mass, eight were from the surrounding bone and sixteen from the periosteum, of which fourteen were from the tympanic and two from the vestibular side. No osteoblasts or osteoclasts were visible.

The focus was also studied by reconstruction plate models.

DISEASES OF THE INNER EAR

Koch [27] studied within one year 61 patients with attacks of giddiness. He prefers the name octavuscrisis to Ménière's disease. Twenty-one of the patients had organic disease of the brain and 2 had epilepsy. The paper abstracted here is a study of the other 38 patients. Of these, only 25 had acoustic symptoms; e. g., 12 had deafness and tinnitus, 7 had deafness alone and 6 had tinnitus without deafness. The deafness was mostly of the nerve stem type. Unlike Dederding, Koch did not find in any of his patients signs of disease of the middle ear or tubal obstruction. The patients were divided into three groups. The first group comprised 3 patients with attacks of the true Ménière type, which developed with a sudden loud noise in the ear accompanied by severe giddiness and vomiting. Two of the patients had one-sided deafness and buzzing, and the other had only buzzing. There was spontaneous nystagmus of the second or third degree to the sound side, which slowly disappeared after from three to four weeks. Cochlear

25. Guggenheim, L. K.: Otosclerosis in a Seven Months Fetus, Ann. Otol., Rhin. & Laryng. **42**:690 (Sept.) 1933.

26. Wilson, J. G., and Anson, B. J.: Form and Structure of an Area of Otic Sclerosis in the Temporal Bone of an Adult, Arch. Otolaryng. **18**:291 (Sept.) 1933.

27. Koch, J.: Beitrag zur Frage der Entstehung, Beurteilung und Behandlung von Erkrankungen mit anfallsweise auftretenden Vestibularschwindel (Oktavuskrisen), Arch. f. Ohren-, Nasen- u. Kehlkopfh. **134**:314, 1933.

symptoms remained even after the vestibular symptoms had disappeared. Functional tests revealed a loss of function on the affected side which was complete and permanent. All 3 patients had only the one attack. Two of them had arteriosclerosis, and the third had had a severe emotional crisis.

In the second group (22 patients) there was a sudden onset of giddiness, but this was not so severe as in the first group. Some giddiness persisted and became worse from time to time. There was a difference of vestibular tonus on both sides in 19 of the patients. In 3 of them there was lowered activity on the affected side. In all the cochlear symptoms slowly increased.

The third group (13 patients) showed only vestibular disturbances. The symptoms began with feelings of giddiness which lasted for weeks or months and were accompanied by a feeling of pressure in the head, sweating, etc. The symptoms gradually became worse and later occurred in regular attacks, with headache, vomiting, sweating and diarrhea. Labyrinthine tests always showed a difference in tonus. Taking all 3 groups together, there was a predominance of the experimental nystagmus to one side in 32 persons.

With regard to the etiology, the attacks in the 3 patients in the first group must have been of labyrinthine origin, and were probably due to an interference with the circulation from sclerosis in 2 of the patients and from spasm in the third patient. In 3 other patients a peripheral circulatory disturbance was believed to be the cause. In the intervals there was only slight inner ear deafness. In all 6 there was spontaneous nystagmus to the sound side. The caloric test gave a negative or diminished response on the affected side. The galvanic reaction was equal on both sides.

Of the 19 patients with tinnitus on one side, there was a preponderance of experimental nystagmus to the diseased side in 12 and to the sound side in 7. They were more easily stimulated on the diseased side by heat, cold and rotation. The galvanic reactions, on the other hand, were equal. Koch confirms Grahe's observation that with peripheral labyrinthine irritation the perception of position is directed to the sound side. With lesions of the medulla there is dissociated perception of position, and the conditions can be differentiated in this way. He found in cases of tumor of the brain that absence of galvanic nystagmus on the diseased side indicates a central lesion. This was proved in 5 cases of tumor of the cerebellopontile angle which showed absence of galvanic reaction on the affected side.

Koch believes that vasomotor disturbances are probably the underlying cause of Ménière's disease or octavuscrises, whether they are of labyrinthine or of central origin. Sweating, diarrhea, pain in the abdomen,

etc., point to disturbance of the sympathetic nervous system. Koch outlines the numerous methods of testing the sympathetic system. An unstable nervous system is usually caused by a constitutional disturbance, but it may be brought about by trauma to the skull or by psychic excitement. There is a definite connection between octavuscrisis, migraine and epilepsy and also between glaucoma and Ménière's disease. Three of Koch's patients had had migraine for years, and 17 had one-sided headache during the attacks.

The etiology was determined in 30 of the 38 cases as follows: influenzal encephalitis, 3; disturbance of sexual life, 2; psychic trauma, 1; cranial injury, 6; nicotine poisoning, 1; polycythemia, 1; eosinophilia, probably of allergic origin, 2; pyorrhea, 2 and tonsillar sepsis, 2. In 2 cases there was a connection between the octavuscrises and the glaucoma. Cerebral arteriosclerosis was diagnosed without high blood pressure by examination of the retina. As may be seen, the causal factors differed widely, and each case had to be worked out individually and treatment given along appropriate lines. Fair success was obtained.

The vestibular disturbances and tinnitus may be treated symptomatically with some success. A sodium bromide, strontium chloride and urea mixture, which stimulates the sympathetic nervous system and has a sedative effect, used intravenously is of benefit. Epinephrine and racemic ephedrine are of no use. For obstinate tinnitus, a combination of papaverine and phenyldimethylpyrazolon is recommended. Bulbocapnine is said to stop the attacks.

In a second paper, Koch [28] reports further observations on the subject of octavuscrisis in cases with organic disease of the brain. Twenty-three patients were studied in collaboration with a neurologist. In 7 of the cases the diagnosis was confirmed by operation or autopsy, and in the rest it was clinically certain.

Several of the cases (meningitis serosa and epilepsy) showed that differences in tonus of the two vestibular organs may be due to increased intracranial pressure or to vascular disturbances. Disturbance of cochlear function occurred only when there was direct interference with the cochlear nerve tracts, as in tumors of the nerves or nerve centers. There was no disturbance from distant tumors. Even in some tumors of the cerebellopontile angle, the cochlear nerve escaped damage. In 1 case of temporal tumor there was deafness on the opposite side from pressure on the nerve center. In 1 case of a medullar tumor there was combined deafness on both sides due to pressure on the cochlear fiber crossing. In 12 of the 23 cases, subjective and objective symptoms

28. Koch, J.: Ueber Störungen der Cochlear- und Vestibularfunktion bei Hirnerkrankungen, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **135**:232, 1933.

were absent, but, on the other hand, in every case there were vestibular disturbances and either spontaneous symptoms or experimentally demonstrable variations.

Koch divides the cases into two groups with reference to the spontaneous symptoms: (1) those with a unilateral lesion and (2) those with a median lesion and a generalized increase in pressure. In the first group the spontaneous nystagmus was easily distinguished from the experimental. Spontaneous pointing deviation could also be suppressed by vestibular stimulation in most cases. Spontaneous tendency to fall in a certain direction could, on the other hand, not be suppressed or changed in any of the cases in the first group. In cases with no spontaneous nystagmus a latent tendency could be demonstrated by having the patient shake his head vigorously or by stimulation with a weak galvanic current, when the nystagmus became evident. This maneuver succeeded in many instances. The slow component of this latent nystagmus corresponded with the direction of falling.

The cases in which the vestibular tests were performed fell into three categories: (*a*) those in which there were normal results (1 case of cyst of the fourth ventricle, 1 case of tumor of the vermis and 2 cases of parietal tumor), (*b*) those in which there was lost vestibular activity (1 case of tumor of the acoustic nerve and 1 of medullar tumor) and (*c*) those in which experimental nystagmus was stronger to one side (17 cases). The predominating nystagmus in the majority of cases was to the opposite side (8:4).

According to Koch, the symptoms in the cases of distant tumors with increased intracranial pressure are probably not caused by the direct effect of pressure on the labyrinth, as Wittmaack has shown that the cochlea is more vulnerable to pressure than the vestibule, and in most of these cases the vestibule was more affected than the cochlea. The fact that the galvanic reaction was absent in some instances indicates a central lesion. Koch found the bipolar galvanic test as reliable as the unipolar.

In 2 cases an abnormal reaction was converted into a normal reaction after treatment by operation and roentgen therapy, respectively.

From the study of cases of tumor of the brain and octavuscrisis, Koch concludes that differences in tonus must be due to central damage or to stimulation. The common occurrence of differences in vestibular tonus makes necessary the use of the rotation test, hot and cold douches and the galvanic test. Hot douches will often clear up the diagnosis when the results from the other tests are inconclusive. The observations of Vogel that in cases with differences in tonus a latent nystagmus may be discovered by having the patient shake the head or by using a weak galvanic current were confirmed by Koch. Testing with the

Grahe table (*Liegetisch*) brought out some abnormalities not discovered by other means. Muck's test was found to be of no diagnostic value.

Glasscheib [29] differentiates the causes of vertiginous attacks into the following groups: (1) arteriosclerosis or angiospasms, which may or may not be syphilitic; (2) lead or nicotine poisoning; (3) allergy, producing a vagotonus or vasodilator effect, and (4) hormonal, i. e., ovarian or suprarenal disturbances, which are sympathicotonic or vasoconstrictor in their effect.

Glasscheib advises the use of choline to prevent vasoconstriction and small doses of iodine given parenterally to stop secretion from the endothelium. He had treated 8 women with vertiginous attacks; in 1 they were of menstrual origin, in 5 they occurred during the climacteric and in 2 they were due to sexual abuse.

Koch and Rothmann [30] report a case of polycythemia with attacks typical of Ménière's disease. Treatment consisted of an excess of fat in the diet with no meat or salt. With improvement in the blood, the attacks of giddiness ceased.

Berggren,[31] in a paper on the occurrence of Babinski's sign in cases with Ménière's syndrome, discusses the significance of the former, which is generally believed to be positive evidence of organic disease of the nervous system. It can, however, be produced by drugs such as strychnine or scopolamine. Four cases are reported in which Babinski's sign was present during attacks of vertigo. In the first case, that of a 42 year old woman with otosclerosis, there was a sudden attack of severe giddiness accompanied by a positive Babinski sign which disappeared after two days. The second case was that of a man of 47 with progressive deafness. He had had several previous attacks of vertigo. Babinski's sign was present during, and for a number of days after, the attack. The third case was that of a woman of 40 with no previous aural symptoms. There was a sudden onset of severe giddiness accompanied by slight weakness of the right hand and slight aphasia. Babinski's sign was positive on the right side but disappeared in two weeks. The patient has since been observed for two years, but no positive neurologic signs have been discovered. The fourth case was that of a woman of 28 with progressive deafness. During the attack Babinski's sign was present on one side. The retinal vessels were contracted. Babinski's sign disappeared immediately after the attack.

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29. Glasscheib, A.: Zur Pathogenese und Therapie des labyrinthären Drehschwindelanfalles, Monatschr. f. Ohrenh. **66**:274, 1932.

30. Koch, J., and Rothmann, H.: Ménièreartige Erscheinungen bei Polyzythämie, Med. Klin. **29**:320 (March 3) 1933.

31. Berggren, S.: Ueber das Vorkommen von positivem Babinski bei Ménièreschem Symptomenkomplex, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **134**:273, 1933.

In only 1 case did Babinski's sign seem to be of serious prognostic import. It would appear that in exceptional cases the factors that produce Ménière's syndrome could sometimes extend to the pyramidal tracts.

Hautant, Aubry, Caussé and Ramadier, in a comprehensive monograph,[32] discuss the subject of vertigo from all angles. Unfortunately, the article was not available to me for abstracting and can only be mentioned here.

Haymann,[33] at the meeting of the Gesellschaft deutscher Hals-Nasen- und Ohrenaerzte in Bad Ems, reported 3 cases with unusual functional tests. All 3 patients complained of attacks of giddiness and had slight spontaneous nystagmus and impaired hearing on one side. Caloric tests with 20 cc. of water at 16 C. produced a normal reaction after a latent period. Syringing the other side increased the spontaneous nystagmus. The diseased side was then syringed with water at 44 C., which produced a horizontal-rotatory nystagmus to the opposite side. The tests were repeated several times for verification.

There was deafness on one side with spontaneous nystagmus to the sound side in all 3 cases. One may possibly have been a case of herpes. In all 3 cases the attacks ceased a short time later. Haymann suggested a nuclear disturbance as a tentative explanation.

THERAPY OF INNER EAR DISTURBANCES

In an article on the influence of calcium on diseases of the ear, nose and throat, Nühsmann[34] emphasizes the satisfactory effects of calcium on Ménière's syndrome. Six and a half years ago the author himself began to have attacks of giddiness accompanied by noises in the ears. No definite cause for the condition could be found in spite of the most thorough investigation. There was a definite increase in the excitability of the vestibular apparatus with the caloric test. Treatment had no effect in spite of the fact that every known remedy was tried. Nühsmann happened to read of the influence of calcium on giddiness and at once tried an intravenous injection of calcium chloride with urea with immediate improvement. After 12 injections there was a complete cure with no recurrence, although the illness had been getting gradually worse for six months.

Since then Nühsmann has used calcium in all similar cases with most satisfactory results. All his patients were cured within five or

32. Les vertiges, Ann. d'oto-laryng., Jan., 1933, p. 2.

33. Haymann, L.: Ueber eine ungewöhnliche Beobachtung bei der calorischen Labyrinthprüfung, Ztschr. f. Hals-, Nasen- u. Ohren. **31**:380, 1932.

34. Nühsmann, T.: Ueber die therapeutische und prophylaktische Wirkung des Calciums bei Erkrankungen der oberen Luft- und Speisewege und der Ohren, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **134**:330, 1933.

six weeks. The hearing, however, when affected, did not improve. Of 33 patients, only 4 had recurrences, and all recovered promptly under renewed treatment. Nühsmann attributes the beneficial results of calcium to its effect on the vasomotor system and to the production of a reduced permeability of the vessels. The preparation of choice is calcium gluconate, which can be given intravenously, intramuscularly or by mouth. Its toxicity as compared to that of calcium chloride is as 1:4.25. There is no tendency to local necrosis. It can be obtained in ampules of 10 or 20 per cent. Nühsmann recommends 10 cc. of a 10 per cent calcium gluconate every two days for from 12 to 20 injections. Later he gives 2 effervescent tablets daily for two months.

Cairns and Brain [35] report 4 cases of severe vertigo treated by division of the eighth nerve with the technic developed by Dandy.[36] The approach is from behind the mastoid. A large area of the cerebellum is exposed, and the brain is lifted up, exposing the facial and eighth nerves entering the internal auditory meatus. The facial nerve is identified by means of a gentle faradic current, and the two branches of the eighth nerve are divided. All 4 patients were immediately relieved of their symptoms, though all had diplopia for a short time.

INJURY TO THE EAR FROM STRONG ELECTRIC CURRENTS

Danger from electric shock does not depend on the voltage, according to Perwitzschky.[37] Deaths have been known to occur from contact with currents of 40 volts, while some shocks from contact with 1,000 volts did little damage. The amperage is the important factor. This is not absolute, as the degree of injury depends also on the resistance of the tissues. The more the resistance the greater the damage to the body. There is little reliable information on this subject. Direct and alternating currents have much the same effect. The portals of entry and exit have little relationship to the organ affected.

Perwitzschky collected data from 23 cases in the literature and adds a case of his own. A man of 43 received a momentary shock from a current of 250 volts. He at once noticed a singing in his left ear. There were no other immediate effects. That night the tinnitus became very marked, and he noticed a feeling of deafness in the ear. A specialist saw him on the next day and found total deafness

35. Cairns, H. W. B., and Brain, W. R.: Aural Vertigo: Treatment by Division of the Eighth Nerve, Lancet **1**:946 (May 6) 1933.

36. Dandy, W. E.: Ménière's Disease: Diagnosis and Treatment; Report of Thirty Cases, Am. J. Surg. **20**:693 (June) 1933.

37. Perwitzschky, R.: Ueber die Schädigungen des Gehör- und Gleichgewichtsorganes durch den elektrischen Starkstrom, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **134**:345, 1933.

in the affected ear. Two days later the patient had a dull feeling all over the left side of the face, and partial anesthesia was noted. There was no giddiness or vomiting. Two months later the patient began to have headaches, which gradually became more severe. He had been examined a short time before the accident by an otologist who had found his hearing to be normal. On examination by Perwitzschky, there was no spontaneous nystagmus and the vestibular apparatus reacted normally, but there was total deafness on the one side.

In the analysis of the cases from the literature some curious facts were found. In 1 case in which the pinna and part of the pyramid were destroyed the hearing was normal. No conclusions could be drawn from the character of the current. In cases in which there was a disturbance in the hearing due to electric shock, the weakest current was 120 volts and the strongest, 50,000 volts. In the great majority of the cases in which the type of deafness was mentioned it was of the inner ear type (9 cases), while in only 2 was it of the middle ear type. Immediate deafness was noted in 4 cases, while delayed onset of deafness occurred in 8 cases. In some of these, however, there had been tinnitus immediately, and this may perhaps be regarded as the first sign of injury to the acoustic nuclei. The onset of disturbances in hearing may occur as late as two years after the accident, hence in compensation cases care must be exercized in giving a decision. Improvement is rare, but it sometimes occurs.

Four patients had disturbances of balance, but only 1 had isolated vestibular symptoms without loss of hearing.

No histologic material was available to the author, but Jellinek, in experiments on animals and in autopsy material, found marked damage to the ganglion cells in the brain. There were vacuolation and complete destruction of the cell nucleus. Characteristic changes were noted in the blood vessels. The arteries of the brain were unusually narrow, while the veins were greatly distended. Clinically, Jellinek found increased pressure of the blood and of the cerebrospinal fluid. According to Panse, there are two kinds of damage: destruction of the nerve cells through the direct action of the current and through the later vascular disturbances and edema of the brain. Jellinek found delayed damage in three fourths of his cases.

SEASICKNESS

Quix,[38] after an intensive study of seasickness, states that the optimum position for avoiding seasickness is flat on the back with the head thrown back slightly. This he finds, is the common experience

38. Quix, F. H.: Die Otolithentheorie der Seekrankheit, Ztschr. f. Hals-, Nasen- u. Ohrenh. **32**:279, 1932.

of most people. In this position none of the otoliths exercise any pressure on the maculae, and the movements of the ship are not rapid enough to stimulate them to any great extent. The stimulus is produced by the alternate changes in pressure. According to Quix, the maculae are stimulated by the pressure of the otoliths. The amount of stimulus is extremely variable and changes with the position of the head.

From calculations of the angular acceleration of the movements of ships, Quix concludes that the semicircular canals are not sufficiently disturbed to be stimulated and, therefore, that they play no part in the causation of seasickness.

A paper by Werner [39] on the function of the sacculus contains some interesting material. Little is known of the function of the sacculus. Noting that in the carp there is a connection between the sacculus and the swim-bladder and that in the shark the labyrinth is open to the sea water, Werner had an idea that in mammals the sacculus might serve to measure atmospheric pressure. Accordingly, he carried out some experimental work on guinea-pigs. The main idea was to have the guinea-pigs under continuous pressure while they were being fixed. The animal was decapitated, and the head put into a vessel with fixing fluid. The pressure was raised and kept raised for several days. The pressure was checked with a mercury manometer. Controls were made of 6 other animals at 75 cm. of mercury. Werner found that the epithelium of the macula sacculi varied in height from 17 to 27 microns, while in the controls it was 23.5 microns.

In these experiments the cells were still alive when the pressure was exerted. The same experiment was tried at varying periods after death. Werner obtained the same result thirty minutes later. One hour later the effect was slight, and two hours after death there was no change. Werner argues from this that the results cannot be due to mere mechanical pressure. The macula utriculi showed almost no change.

According to Werner, these facts prove that the macula sacculi has a specific reaction to air pressure. A difference in pressure of 10 cm. of mercury, which corresponds with the normal physiologic range, produces a change of 1 micron in the sensory epithelium.

In another paper on the effect of the removal of the otolithic membrane by centrifugation, Werner [40] reports the results of studies on the state of the sensory epithelium. Soon after the otolithic membrane is removed, the cells look normal. An hour later the nuclei show vacuoles

39. Werner, C. F.: Zellreaktionen im inneren Ohr bei Veränderungen des Luftdruckes, Ztschr. f. Hals-, Nasen- u. Ohrenh. **32**:544, 1933.

39. Werner, C. F.: Zellreaktionen im inneren Ohr bei Veränderungen des Luft-Otolithenmembran, Ztschr. f. Hals-, Nasen- u. Ohrenh. **33**:593, 1933.

and other changes. Some time later the sensory hairs collapse, and several weeks later they again become erect with a new pseudo-otolithic membrane without otoliths. Some of the static results of centrifugation may be due not merely to the removal of the otolithic membrane but also to damage to the sensory cells.

It has long been known that certain drugs such as chloroform or cocaine introduced into the middle ear of guinea-pigs produced rapid symptoms of labyrinthine destruction. There had been a certain amount of speculation as to how the drugs reached the labyrinth, and Quix and von Egmond [41] set out to clear up this point. They used a solution that could be seen in sections which contained potassium ferrocyanide, iron and ammonium citrate and cocaine hydrochloride. It was injected into animals through the drum membrane, and the animals were killed at varying periods after labyrinthine symptoms appeared. The sections were treated with hydrochloric acid which produced prussian blue in the tissues.

Twenty guinea-pigs were used. Fourteen were given injections in the upright position and 6 were held on their backs.

In the living animal the salts for the most part flow through the bony canals of the wall directly to the base of the skull, the cranial cavity, the cochlea and the canals. In the cochlea, the blue was found in all the scalae. It had diffused through Reissner's membrane to the ductus cochleae and reached the organ of Corti.

From there it was carried away by the veins to the modiolus. There was no blue in the ganglion or nerves. None of the salts diffused through the oval windows, and only a very little through the round window. In the semicircular canals the dye was found mostly in the perilymph. Some of it got under the maculae but did not reach the sensory epithelium.

In dead animals the salts diffused slowly through the round windows and not through the bony walls. Some dye was found in the spiral ligament and stria vascularis, while in the animals that had been given injections while alive there was none in that location, indicating that there is a current of endolymph from the stria vascularis.

WEAVER'S DEAFNESS

McKelvie [42] carried out a series of investigations on weavers in the mills in Lancashire in 1926, which was published in 1933. One

41. Quix, F. H., and von Egmond, A. A. J.: Ueber das Eindringen von Eisen-Cocainsalzlösungen aus dem Mittelohr in das Labyrinth von Meerschweinchen, Ztschr. f. Hals-, Nasen- u. Ohrenh. **32**:26, 1932.

42. McKelvie, W. B.: Weaver's Deafness, J. Laryng. & Otol. **48**:607 (Sept.) 1933.

thousand and eleven weavers were given hearing tests by conversational voice and whisper at 14 feet. Those who showed a defect in hearing were subjected to further examination. Of these, 246 (24.3 per cent) had some degree of deafness. Sixty-eight (6.7 per cent) suffered from nerve deafness and 178 (17.6 per cent) from other forms of deafness. The percentage of all forms of deafness increased with each decennial period of employment. No nerve deafness was found in persons employed less than ten years. The increase in the number affected occurred mainly after twenty years. The percentage of acute and chronic suppuration of the middle ear was no greater than that in the general population. The noise in the mills was appalling and was mainly caused by the shuttles and to a lesser extent by the rest of the machinery. McKelvie believes that obturators and floor-mats are not enough to prevent deafness and that silent looms are the only solution.

TREATMENT OF DEAFNESS

Voss [43] has been using the U rays of Mülwert in the treatment of deafness from various causes. He previously published an account of this method, which met with a mixed reception. The instrument gives off waves considerably above the upper tone limit of sound. He has treated 400 persons, some with considerable success. He argues that if one can give any relief to persons with otherwise incurable deafness it is worth while. He had tried the galvanic current also and with both methods had obtained great relief from subjective noises and some improvement in hearing, including that on the untreated side. Some surprisingly good results are reported in the paper.

Frenzel and Scheiff,[44] on the other hand, tried the U rays on 63 ears in 41 patients with no more improvement than can be explained as the normal variations in hearing in deaf people.

Perwitzschky [45] also studied the effects of ultra-acoustic waves in the treatment of deafness. He used the U ray machine of Mülwert which is capable of giving off from 16,750 to 63,000 hertzian waves. He made a number of physical and clinical tests of the machine. He treated 164 deaf ears, of which 64 had tinnitus. There was improvement in 19 cases, while in 105 the condition was unchanged and in 40 the result was questionable. The last group consists of patients whose hearing had previously varied considerably from time to time.

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43. Voss, D.: Ultraschallwellen im Dienste der Behandlung chronischer Schwerhörigkeit, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **135**:258, 1933.

44. Frenzel, H., and Scheiff: Zur Ü-Strahlenbehandlung der Schwerhörigkeit, Ztschr. f. Hals-, Nasen- u. Ohrenh. **31**:390, 1932.

45. Perwitzschky, R.: Ueber den therapeutischen Einfluss kurzer Schallwellen auf das Ohr, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **136**:124, 1933.

No improvement was obtained in cases of senile deafness or of deafness due to commotio or to an adhesive process. The degree of improvement in deafness due to otosclerosis averaged 2.2 per cent; in inner ear deafness, 5.9 per cent; in mixed deafness, 17.7 per cent; in deafness following radical operations on the ear, 25 per cent; in deafness due to chronic otitis, 27 per cent, and in deafness as residue of otitis media, 39 per cent. The improvement was entirely in the hearing for the lower tones. There was no effect on the hearing for the upper tones. Most success was obtained with frequencies of 30,000 hertzian waves. If there was any improvement, it was noticed at the first treatment. There was much more relief from subjective noises than there was improvement in the degree of hearing. The effect of the waves on subjective noises differed from the effect on the hearing in that in the first instance there was equal improvement with high and low frequencies.

Perwitzschky does not recommend the U rays, as the use of them has not been perfected as yet.

EFFECT OF ROENTGEN RAYS ON HEARING

Girden and Culler [46] exposed two dogs to roentgen rays over a period of months. They used the conditioned response as a guide to the auditory acuity. An initial rise in auditory acuity results from exposure to small doses of the roentgen rays generated at 85 kilovolts and 5 milliamperes. This increase in hearing is only transient, the effect lasting from two to four weeks. Cumulative doses up to 11,000 roentgens in one animal and 4,400 roentgens in another did not result in impairment of hearing or deafness. There was some burning of the skin, but this can be avoided by spacing larger doses over longer periods.

PSYCHIC TREATMENT OF DEAFNESS

Roggenkamp [47] selected 10 patients with different types of organic deafness to see if they improved under suggestion. Light hypnosis was used, and the patients were told they were going to be treated by rays. Some harmless kind of ray was used. The results were very much what was to be expected, namely, nil.

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46. Girden, E., and Culler, E.: Auditory Effects of Roentgen Rays in Dogs, Am. J. Roentgenol. **30**:215 (Aug.) 1933.

47. Roggenkamp, W.: Ueber einem Versuch der psychischen Beeinflussung organisch Schwerhöriger, Ztschr. f. Hals-, Nasen- u. Ohrenh. **33**:94, 1933.

Abstracts from Current Literature

Ear

AURAL VERTIGO: TREATMENT BY DIVISION OF EIGHTH NERVE. HUGH CAIRNS, Lancet **1**:946 (May 6) 1933.

The cases of four patients with severe aural vertigo treated by division of the auditory nerve are reported. With minor variations, the clinical picture was the same in all cases, and conformed to the classic description of Gowers. In each instance the patient had been growing deaf in one ear for some time before the attacks began. The attacks consisted of vertigo of sudden onset; three of the patients fell without warning, and the fourth frequently had a sensation of insecurity. In addition, external objects appeared to rotate; this symptom often was so aggravated by movement that the patients had to remain still, usually in a recumbent position. The vertigo persisted for several hours, was associated with vomiting in all but one case, and terminated in sleep. Each patient was incapacitated for at least one day during an attack. In the initial stage of the attacks one patient became completely blind for a moment, while another saw lights and stars; another felt intensely cold or hot, along with a feeling of impending doom. One patient, an instructor in drills, attributed his attacks to severe exertion, but the others could suggest no cause.

Milder reactions, unaccompanied by falling, occurred in all cases, and were often brought on by sudden movement of the head; in two patients mild attacks, described as "swimming of the head" and "giddiness on rising from the stooping position," occurred for some years before the severe attacks. All four patients were relieved of their vertigo following the operation. They have returned to their original employment amidst noise and machinery.

Some of the physiologic results of the operation include vertigo and vomiting, which is quite transient. Nystagmus is present and is most striking to the opposite side. It persists in diminishing intensity for from two to three weeks. Diplopia, explained by the authors as due to skew deviation of the eyes, persisted intermittently for from one to three weeks.

BECK, Buffalo. [ARCH. NEUROL. & PSYCHIAT.]

AUDITORY AND NEUROLOGIC SEQUELAE CONSECUTIVE TO THE ACTION OF TRAUMATIZING TELEPHONIC NOISES. A. MORIEZ, Rev. d'oto-neuro-opht. **11**: 171 (March) 1933.

On the basis of a personal observation, Moriez believes that actual lesions may be produced in the ear and neuraxis by telephone noises, that electric action may be eliminated as a factor in such injuries and that there must be, at least, a physiologic synergy between the extrapyramidal apparatus and the central cochlear pathways for the following reasons: (1) cochlear lesions may have a secondary action on plastic tonus, with heterolateral predominance; (2) mesencephalic lesions may have a secondary cochlear repercussion; a contralateral tinnitus in a patient with left-sided parkinsonism was relieved at once by an injection of insulin and dextrose, given to combat the hypertonia. Nyssen and Helsmoortel have shown that intense auditory excitations increase arterial pressure through mechanical shock of the extracochlear receptor organs.

A patient, aged 65, who had good hearing and was in good health except for marked arterial hypertension, received from a telephone receiver a tactile shock in the left ear and surrounding area, the shock being followed by a shrill noise in the apparatus. There was no loss of consciousness or malaise. Tinnitus began at once in the ear and had continued for four years. A distinct cochlear deafness

supervened. Repeated vestibular tests gave normal results. Several weeks after the accident, trembling appeared in both hands and was especially marked in the right hand. At the time of examination, four years after the accident, the following neurologic syndrome existed: (1) direct oculosympathetic phenomena with slight photophobia; (2) trembling of the arms, with undoubted crossed predominance; (3) a slight crossed hypertonia.

The hypothesis expressed is that the sudden sharp noise raised the arterial tension (already elevated) and caused a hemorrhage in the cochlear portion of the ear, probably in the spinal ganglion. Degeneration of the nerve pathways began and eventually extended to and affected the extrapyramidal apparatus.

DENNIS, Colorado Springs, Colo. [ARCH. NEUROL. & PSYCHIAT.]

VASOMOTOR SYNDROME OF THE LABYRINTH. H. PROBY, Rev. d'oto-neuro-opht. **11**:182 (March) 1933.

Many vestibular disturbances that are not associated with definite pathologic changes are often overlooked. Whatever their cause, all may be traced to a circulatory disturbance. The reflex may be direct (foreign body or cicatrix), or may arise from a chronic infection, suppurating focus or hepatic insufficiency. Often no cause is found. An illustrative case is that of a married woman, aged 41, who suddenly experienced a sharp attack of vertigo and vomiting, which confined her to bed for eight days. The attack was ameliorated by the application of leeches to the mastoid region, but the vertigo, though less intense, persisted. Three years previous to the attack the patient suffered loss of consciousness for a few seconds. In other respects the history and all examinations gave completely negative results, except in the internal ear. Bone conduction and the reaction to cold irrigations of the ear were much reduced. Under treatment designed to modify the labyrinthine circulation, the vertigo diminished, and the normal excitability of the labyrinth returned. It is the evolution of the disease that differentiates the cases of circulatory disturbances from those of chronic infection of the labyrinth. The lesions disappear in the former and persist in the latter.

DENNIS, Colorado Springs, Colo. [ARCH. NEUROL. & PSYCHIAT.]

THE MECHANISM OF THE FISTULA SIGN. F. J. COLLET and R. MAYOUX, Rev. d'oto-neuro-opht. **11**:427 (June) 1933.

Two hypotheses explain the fistula sign. The first is that movement of the endolymph causes the nystagmus, and the second is that the fistula sign is an otolithic reaction. Herzog believed that to produce the fistula sign two weak points in the labyrinth capsule were necessary: the fistula and the fenestra rotunda. Most often the compression acts through the fistula, and nystagmus toward the diseased side is produced; if the force acts through the fenestra rotunda, the nystagmus is toward the healthy side.

Two cases are recorded. In the first, of a patient with a perforation of Shrapnell's membrane of the left ear, compression produced nystagmus with the slow component to the right; aspiration reversed the nystagmus. Thirty days later the same procedures produced opposite directions of the nystagmus. The second case was that of a man who had had a radical operation on the mastoid on the left side. Compression with the Siegle speculum produced nystagmus to the left, while aspiration caused poorly marked movements of the slow component to the left. Direct pressure on the horizontal canal produced marked nystagmus to the left (slow component to the right); decompression caused slight slow movements to the left. Direct pressure over the fenestra rotunda produced slight movements (slow component) to the right; decompression caused distinct nystagmus to the right (slow component to the left). The direction and the intensity of the nystagmus conformed to Ewald's experiments. These observations support the

conclusion that change in the direction and intensity of nystagmus from compression and aspiration may be explained by a current of endolymph toward or away from the ampullae.

DENNIS, Colorado Springs, Colo. [ARCH. NEUROL. & PSYCHIAT.]

A CEREBELLAR TUMOR IN THE REGION OF THE VERMIS, DIAGNOSED BY VESTIBULAR EXAMINATION. J. BARBIER and R. MAYOUX, Rev. d'oto-neuro-opht. **11**:518 (July-Aug.) 1933.

The patient suffered with slight equilibrial disturbances, frontal headache and vertigo. The eyes were normal. The tension of the spinal fluid was 29 (Claude); the Queckenstedt sign was negative; the fluid contained albumin (0.2 Gm.) and 2 cells per cubic millimeter, and the Bordet-Wassermann test was negative. Neurologic examination revealed only disturbed gait while walking with the eyes closed. Vestibular examination showed bilateral, spontaneous, horizontal nystagmus, a tendency to fall backward, which was not influenced by the caloric test, normal excitability of the horizontal canals and inexcitability of the vertical canals. Operation revealed a cystic glioma of the right cerebellar hemisphere near the median line. The interest of the case lies in the paucity of neurologic findings and the precision of the labyrinthine signs. The bilateral and symmetrical inexcitability of the vertical canals, together with the absence of modification of falling by cold irrigation, in a patient with disturbance of equilibrium and good hearing warranted the diagnosis of a tumor of the cerebellum in the region of the vermis. Wishart showed that median cerebellar tumors caused symmetrical vestibular disturbances, and Bárány proved that in these cases the direction of falling was not modified by vestibular stimulation or the position of the head.

DENNIS, Colorado Springs, Colo. [ARCH. NEUROL. & PSYCHIAT.]

LABYRINTH REFLEXES IN GUINEA-PIGS AFTER REMOVAL OF THE OTOLITHS BY CENTRIFUGATION. A. DEKLEYN and C. VERSTEEGH, Arch. f. d. ges. Physiol. **232**:454, 1933.

Tonic labyrinth reflexes can still be elicited after complete separation of the otolith membranes with the maculae. These reflexes seem to start from the maculae utriculi. The reactions on rectilinear movements are also still present; they are probably a function of the semicircular canals.

SPIEGEL, Philadelphia. [ARCH. NEUROL. & PSYCHIAT.]

OBSERVATION OF THE CUPOLA IN THE AMPULLA OF THE PIKE'S LABYRINTH. W. STEINHAUSEN, Arch. f. d. ges. Physiol. **232**:500, 1933.

The cupola was stained with Chinese ink and observed in living pike. Electric stimulation produced typical labyrinthine symptoms without movements of the cupola. Deviation of the cupola in the left horizontal ampulla was induced by mechanical stimulation. Short deviation of the cupola toward the utriculus produced deviation of both eyes to the right; prolonged deviation caused nystagmus to the left. Deviation of the cupola toward the semicircular canal had no effect.

SPIEGEL, Philadelphia. [ARCH. NEUROL. & PSYCHIAT.]

Pharynx

NASOPHARYNGEAL CARCINOMA. O. CHRISTIANSON and S. W. MCARTHUR, Arch. Surg. **27**:1109, 1933.

Three primary nasopharyngeal carcinomas with metastases to the cervical lymph nodes are described. The diagnosis for each patient was made clinically by examination of surgically excised tissues, and the body of one was examined post mortem. Histologically, all the tumors resembled immature squamous or pseudostratified epithelium, but in one the cells tended markedly to assume the arrangement and

structure of squamous epithelium. An essential clinical feature was the insidious and painless bilateral enlargement of the cervical lymph nodes due to metastases. The bilateral distribution of the metastases resulted from the midline location of the primary tumor and the dissemination of the growth into the lymphatics on both sides of the neck. Slight variations in cellular structure occurred in these carcinomas, but the variations were within the limits of the varieties of cells found in the pseudostratified epithelium lining the nasopharynx.

AUTHORS' SUMMARY. [ARCH. PATH.]

THROAT MANIFESTATIONS OF THE BLOOD DYSCRASIAS. EDLEY H. JONES, South. M. J. **26**:550 (June) 1933.

Some blood dyscrasias present such marked manifestations in the throat that otolaryngologists may be consulted before conference is held with an internist.

These dyscrasias may be suspected from the results of simple and common laboratory procedures.

In all suspected cases adequate laboratory examinations should be made.

In all cases, particularly preoperative ones, the history should contain definite information regarding any previous hemorrhages; further, in all preoperative cases the bleeding and coagulation time should be determined.

SCHLUTZ, Chicago. [AM. J. DIS. CHILD.]

ROENTGENOTHERAPY OF TONSILLITIS. E. HASENJÄGER, Med. Klin. **29**:1311 (Sept. 22) 1933.

Since 1929, Hasenjäger has treated forty-seven patients with subacute and chronic tonsillitis by means of roentgen rays. In those cases which show a moderate amount of inflammation, he uses a dosage of from 20 to 25 per cent of a unit skin dose, and in more chronic cases, as much as 40 per cent. Most of his patients were treated only once, although several were treated two or three times at intervals of from four to six weeks. Of thirty-two cases which he was able to follow up, he believes that there was a cure in twenty-three, improvement in five and no improvement in four. Half the patients were children between the ages of 4 and 15 years. Roentgenotherapy can be used in all cases in which surgical intervention is contraindicated, save perhaps in children under the age of 2 years.

Hasenjäger also treated fifteen patients with acute tonsillitis, lymphadenitis or peritonsillitis, and seemed to get satisfactory results. The danger of increased swelling and possible edema of the glottis seems slight even in the treatment of patients with very severe cases, unless edema of the glottis is already present.

DOOLEY, Kent, Conn. [AM. J. DIS. CHILD.]

EHRLICH'S NEGATIVE PHASE AS A CONTRAINDICATION FOR TONSILLECTOMY. Z. WEIN, Monatschr. f. Ohrenh. **68**:52 (Jan.) 1934.

Wein describes the case of a girl, aged 18, with infected tonsils and signs of renal irritation. He first removed a small retention cyst from the upper pole of the left tonsil. Healing of the wound occurred without any untoward event, and a week later he performed a tonsillectomy. Four days after the operation fever, leukocytosis and other signs of sepsis developed. Short chain streptococci were isolated from the blood in pure culture. The patient died eleven days after the tonsillectomy. The author feels that this unfortunate event was probably due to the stimulation of the antibody-producing cells by the operation on the retention cyst. For a time after such stimulation the power to produce antibodies is lowered. This period of poor antibody production was called by Ehrlich the negative phase. It can be recognized by the fall in Wright's opsonic index. Practically, then, to avoid this phase, at least three weeks should elapse between any nasal or pharyngeal operative procedure and tonsillectomy.

EDITOR'S ABSTRACT.

Nose

NEURORETINITIS OF NASAL ORIGIN. P. BONNET and L. PAUFIQUE, Ann. d'ocul. **170**:606 (July) 1933.

Bonnet and Paufique observed a patient, aged 17, who for ten days had had vision of 1/30 and a wide central scotoma. Ophthalmoscopic examination revealed papilledema affecting one nerve, intense retinal edema and perivascular retinal exudates. Repeated coryza, hypertrophy and polypi of the nasal mucous membrane and the absence of general or serologic symptoms confirmed the conclusion that this case of neuroretinitis had its origin in the paranasal sinuses.

BERENS, New York. [ARCH. NEUROL. & PSYCHIAT.]

BILATERAL ATROPHY OF THE OPTIC NERVE ASSOCIATED WITH UNILATERAL SPHENOID PNEUMOSINUS. T. BENDESCU, Rev. ştiinţ. med. **21**:570, 1932.

A woman, 24 years of age, had for one year remarked a slow but progressive decrease in the vision of both eyes. The history did not give any clue to the cause. Vision in the right eye was 1/20, and that in the left eye, 1/50. The visual field of the right eye showed concentric contraction up to 10 degrees. The visual field of the left eye could not be determined. The reactions of the pupils were normal. There was total simple atrophy of both disks. The physical examination gave negative results. The roentgenogram showed the base of the brain forced upward. This was due to dilatation of the right sphenoid sinus, which was pneumatic. The optic nerve canal showed a kidney-shaped deformation and marked narrowing. The left sphenoid sinus and the ethmoid sinuses were free from pathologic changes. The increase in size of the right sphenoid sinus had brought about the displacement of tissue which was responsible for the alteration of the optic nerve canal and the atrophy of the optic nerve.

The dilatation of the right sphenoid sinus had originated from the chronic hypertension of the air contained in the sinus.

N. BLATT. [ARCH. OPHTH.]

IS "RETROBULBAR NEURITIS" AS OFTEN DUE TO DISEASE OF THE NASAL ACCESSORY SINUSES AS IS GENERALLY HELD? N. BLATT, Tenth Cong. Rumanian Soc. Otorhinolaryng., Bucharest, Oct. 29-30, 1932.

As an etiologic factor in retrobulbar neuritis disease of the nasal accessory sinuses is still enormously overrated. On the other hand, it is evidenced by exact and carefully gathered and interpreted statistics that retrobulbar neuritis is more frequently due to multiple sclerosis than to disease of the nasal accessory sinuses. A statistical table of forty-four cases of retrobulbar neuritis which I have had the opportunity of seeing in the course of fifteen years and observing for some length of time is given. In this table appear the rhinologic diagnosis of the involvements of the nasal accessory sinuses, the instances in which the neurologist was able to find evidence of multiple sclerosis and the instances in which rhinologic operations were performed.

Owing to the protracted observation of the cases these statistics, brief as they are, can be given credit for their objectiveness. The table shows that the number of cures obtained in cases in which operation was performed was not larger than the number obtained in cases in which no operation was performed. Nor was the course of the disease influenced by operation.

In retrobulbar neuritis operative treatment of the concomitant disease of the nasal accessory sinus may, of course, but not necessarily, assist in the cure of the nervous process. In order to influence the optic nerve process, operation should be done only in the presence of a purulent or seropurulent inflammation of a nasal accessory sinus and only when multiple sclerosis is absent. In this respect the ethmoid cells, the sphenoid and frontal sinuses and lastly the antrums of Highmore, in the order mentioned, should be borne in mind as common sites of disease leading to retrobulbar neuritis. One should not, however, assume that

hypertrophy of the nasal mucous membrane, a polyp or a deflection of the septum which happens to coexist is the cause of the retrobulbar neuritis, or expect a cure of the diseased optic nerve from an operation done for one of these conditions.

It should, moreover, be taken into consideration that multiple sclerosis in the first stages of its appearance may be located in the optic nerve, so that retrobulbar neuritis proves an important, indeed, often the only, early symptom of multiple sclerosis.

That opening of the nasal accessory sinuses, even if they show only slight lesions, may in some cases be followed by improvement of the diseased optic nerve is mentioned only to point out that retrobulbar neuritis due to multiple sclerosis is known to improve in some cases spontaneously and quickly.

N. BLATT. [ARCH. OPHTH.]

LESIONS OF THE CONTENTS OF THE ORBIT DURING ENDONASAL CURETTING OF THE ETHMOID CAVITY: REPORT OF TWO CASES. H. F. ROESE, Klin. Monatsbl. f. Augenh. **91**:95 (July) 1933.

Two cases of curettage of the ethmoid cavity are reported, during which the lamina papyracea was perforated incidentally.

In the first case, that of a man, aged 42, a considerable hematoma developed immediately in the orbit, coupled with swelling of the lids and double vision, caused by dehiscence of the internal rectus muscle. Infection of the hematoma led to the formation of thick scar tissue around this muscle, which frustrated an attempt to advance it.

The second patient, a woman, aged 30, felt severe pain in her left eye during the curettage of the left ethmoid cavity. Her eye was blind after that day; enophthalmos, slight ptosis and paralysis of the entire oculomotor nerve were present on the next day. No hemorrhage occurred in the nose or in the orbit. The fundus was free from pathologic changes, until genuine optic atrophy revealed the presence of a rupture of the optic nerve three weeks later. The enophthalmos was explained as the result of a hernia-like escape of some of the contents of the orbit through the perforated lamina cribrosa into the ethmoid cavity. The conjunctiva and cornea were asensitive, indicating dehiscence of the first branch of the trigeminus nerve.

K. L. STOLL. [ARCH. OPHTH.]

CANCER OF THE ANTRUM AND METAPLASIA. W. SCHÜTZ, Ztschr. f. Krebsforsch. **39**:152, 1933.

In a study of the mucosa of the antrum in fifty cases, Schütz could detect metaplasia with certainty in four, cylindric epithelium being altered to that of squamous cell or undifferentiated (basal cell) type. Morphologically, this appeared to be metaplasia of the type which Teutschlaender designated as prosoplastic. Metaplasia by dedifferentiation, either direct or indirect, did not appear to occur. The change was apparently accomplished by the basal cells. Schütz regards it as a precancerous process which in suitable subjects develops into malignant neoplastic growth.

H. E. EGGERS. [ARCH. PATH.]

CHOANAL POLYPS. T. VON BAJKAY, Ztschr. f. Laryng., Rhin., Otol. (Teil 1: Folia oto-laryng.) **24**:321 (Nov.) 1933.

Von Bajkay discusses the pathogenesis, symptomatology, diagnosis and therapy of choanal polyps. Therapy in cases of retrochoanal polyps must be surgical; irradiation with radium is unsuccessful. The sinus in which the polyp originates is determined and opened, and the diseased mucosa is removed. Incomplete removal of the polyps and continuation of the empyema of the nasal sinuses are responsible for recurrences. At the author's clinic retrochoanal polyps were treated by surgical intervention in eighteen cases. In all the cases the polyps were unilateral and isolated. The polyps originating in the middle concha (two cases) were removed

with Struycken's scissors by severing the stem and extirpating the mucosa at the point of insertion of the stem. The polyps located on the edge of the choana (two cases) were removed with the cold snare. The mucosa at the point of insertion was removed with a polyps forceps. In the cases of polyps of ethmoid origin (three cases), the ethmoid sinus was opened, and the degenerated mucosa was radically extirpated. In the cases of polyps originating in the maxillary sinus (eleven cases), the sinus was opened by the Caldwell-Luc method, and the polyp was extirpated, together with the mucosa of the sinus. In 50 per cent of the cases numerous polyps were found in the maxillary sinus; then removal was followed by curettement of the mucosa. No recurrences were observed in these cases.

EDITOR'S ABSTRACT.

Miscellaneous

SPHENO-OCCIPITAL CHORDOMA. MEYER CANTOR and LOUIS D. STERN, Arch. Neurol. & Psychiat. **30**:612, 1933.

Chordoma from the notochordal remnants may be an accidental finding; that is, it may give no symptoms, or it may give a variety of clinical pictures, depending on the location. In the case reported the clinical picture was made up of pain (aching) in the right half of the face, decrease of visual acuity in the right eye and signs of a slight involvement of the third nerve and of increased intracranial pressure (absence of the posterior clinoid processes). A mass was seen pushing into the oral cavity from the right palatal region. It protruded externally in the region of the zygomatic process of the maxillary bone. There were loss of taste in the anterior part of the tongue, immobility of the palate, dysphagia and anesthesia of the right half of the face. Necropsy revealed a tumor protruding from the right palatal region into the oral cavity. It filled the right orbital and nasal cavities and the maxillary, ethmoid and sphenoid sinuses, destroyed most of the base of the skull and pressed on the right hemisphere, involving the second, third, fourth, fifth, sixth and seventh nerves. The tumor was vascular; calcium salts were deposited in the septums which divided the tumor into lobules. These contained physaliform cells, which were arranged in columns and were mostly vacuolated. Many of the vacuoles contained shrunken cells that resembled cartilage cells. There were no metastases.

G. B. HASSIN. [ARCH. PATH.]

CEPHALIC ZONA. J. REBATTU, P. MOUNIER-KUHN, J. DECHAUME, P. BONNET and A. COLRAT, Rev. d'oto-neuro-opht. **11**:333 (May) 1933.

Laryngeal paralysis in zona is always accompanied by otic zona and facial paralysis. In Federici's case the evolution of the paralysis was followed from its beginning, and it strikingly confirmed the Semon-Rosenbach law. Rapid recovery is the rule. Knowledge of lingual paralysis is limited to the observation of Faure-Beaulieu, Mathieu and Cord in 1931: In the course of zona of the face, neck, ear and tongue, homolateral paralysis of the tongue, followed by hemiatrophy with a partial reaction of degeneration of the hypoglossal nerve, was seen. Paralysis of the muscles of mastication would be a logical expectation, but no instance of it was found. Paralysis of the muscles of the neck is very rare.

Sensorial disturbances of the eighth nerve in zona of the geniculate ganglion may involve both the cochlear and the vestibular division or either separately. In eighty-two observations of involvement of the eighth nerve, cochleovestibular disturbances represented 44 per cent, cochlear disturbances, 45 per cent, and vestibular disturbances, 11 per cent. The order of the appearance of the symptoms is: neuralgic pains, eruption, facial paralysis and equilibrial and auditory troubles. Cochlear symptoms may be represented by auditory perversions, hyperacusis or hypo-acusis or diplacusis. Systematic examination is often necessary to discover them, and they are of the nerve type. Auditory disturbances disappear concomitantly with regression of the facial paralysis. The characteristic sign of vestibular disturbance is vertigo, which is often accompanied by nausea and vomiting. The attacks recur

for months and are accompanied by loss of equilibrium and nystagmus directed toward the healthy side. Vestibular examination reveals either hyperexcitability or hypo-excitability of the labyrinth. Recovery within two months is the rule, although exceptions occur. Recrudescence may occur after apparent cure. Probably the primary infection of the geniculate ganglion is propagated along the sheaths to the ganglions of Scarpa and Corti. When suppurative otitis media occurs as a complication, it is explained by rupture of a vesicle, leading to perforation of the membrane.

Theoretically, disturbances of taste should occur in zona affecting the fifth, seventh and ninth nerves, but in practice they are encountered only in zosterian facial paralysis.

No indubitable facts have been adduced to prove involvement of the olfactory nerves in zona. Disturbances of olfaction may be due to the mechanical obstruction offered by swelling of the mucosa of the turbinates and septum. Disturbances of the sympathetic system occur, the syndrome of C. Bernard and Horner being an example. Any part of the system may be involved, from the cutaneous terminations to the bulbar segments, which explains the different manifestations from one case to another.

Alternate hemiplegia, with or without paralysis of the third nerve, has been observed and is due to lesions of the central nuclei. It occurs only in the aged. Schiff and Russell reported a case of zonal encephalitis and André Thomas and Buvat reported one, and cases of zosterian cachexia, all fatal, have been noted. The pathogenesis of these conditions is not clear; they may be due to circulatory accidents occurring in aged persons with fragile vessels following vasomotor disturbances produced by zona.

Clinical forms of cephalic zona are classified as cervical, facial, buccopharyngeal, ophthalmic and auricular. Most often zona of the face is limited to the region of the superior or the inferior maxillary nerves. A diagnosis of buccopharyngeal zona is often possible only when there is association of paralytic phenomena or cutaneous eruption. Auricular zona is divided into simple auricular zona with facial paralysis, auricular zona with auditory disturbances and associated auricular zona (the most common association being with one or more branches of the trigeminus).

Treatment is confined practically to relieving the symptoms and treating complications, although serum from convalescent patients, antidiphtheritic serum, autohemotherapy and arsenic have been used with good effect in shortening the attack.

DENNIS, Colorado Springs, Colo. [ARCH. NEUROL & PSYCHIAT.]

PERITUBAL CANCERS AND THEIR ENDOCRANIAL PROPAGATION. M. JACOD, Rev. d'oto-neuro-opht. **11**:411 (June) 1933.

In 1921, Jacod published in the *Revue de neurologie* a discussion of this subject in which he proposed for the clinical picture the name "syndrome of the petrosphenoid crossroads"; it was afterward called "the syndrome of Jacod." In 1888, Silvio published a complete, detailed report of such a case, but without comment. In the present article a discussion of the general neurologic and rhinologic ideas gleaned from a study of clinical observations and autopsies in cases of peritubal tumors is undertaken.

The anatomy of the nasopharynx demands that malignant tumors of the nasopharynx be placed in two distinct groups: 1. The tumor starts in the vault of the nasopharynx external to the basilar fibrous bundle and grows unhindered toward the oropharynx, the nasal fossae and sinuses and the orbit. 2. It begins beneath the aponeurosis that sheathes the eustachian tube, and the development is guided by the aponeurotic formations and by the anatomic fact that the osseous eustachian tube inosculates with the cartilaginous tube. Since the growth is subaponeurotic, it follows the blood and lymph vessels and extends rapidly through the foramina in the base of the skull and tends to compress the trunks of the cranial nerves, then becoming endocranial. At first the symptoms are purely

auricular: tenacious subacute otitis media with tubal obstruction, recurring exudative otitis media or acute suppurating (or nonsuppurating) otitis media. These symptoms antedate the triad of Trotter: neuralgia of the inferior maxillary nerve, deafness and disturbed motility of the palate. Moreover, when this triad is present early, it points to an implantation outside the aponeurosis. Whenever a patient over 40 years of age presents inexplicable unilateral deep pain and persistent otitis media without a manifest cause for its tenacity, a malignant tubal tumor should be suspected. The pneumatic portion of the petrous tip and the anterior lacerated foramen correspond endocranially to the union of the sphenoid and petrous bones. In the immediate vicinity are the large round foramen, the foramen ovale and the cavernous groove, and this restricted area forms a veritable endocranial vasculonervous crossroads occupied by the trigeminus nerve on one side and by the cavernous sinus on the other. The latter contains the external oculomotor nerve and, near it, the common motor oculi, patheticus and ophthalmic nerves. Medial to it is the optic nerve. The association of truncal paralyses of the second, third, fourth, fifth and sixth nerves is indicated by unilateral neuralgia (gasserian in type) of the fifth nerve, total or subtotal unilateral ophthalmoplegia and unilateral amaurosis. The attack on these trunks is almost simultaneous, and the group of paralyses constitutes a definite syndrome. This is particularly true in cases of sarcoma. The epitheliomas that do not arise on the internal slope of the tubal mouth extend forward at first and later penetrate the skull at divers points outside the petrosphenoid crossroads. The criticism that the syndrome of the petrosphenoid crossroads is often exceeded (paralysis of the last four cranial nerves) may be met by the explanation that these paralyses are caused by distant adenopathies and not by the tumor itself.

DENNIS, Colorado Springs, Colo. [ARCH. NEUROL. & PSYCHIAT.]

RHINOSCLEROMA AT NECROPSY. W. NOWICKI, Beitr. z. path. Anat. u. z. allg. Path. **91**:457, 1933.

Although rhinoscleroma is a common disease in the portion of Poland in which Lemberg is situated, few persons with this disease are seen on the necropsy table, evidently because the disease is rarely the immediate cause of death or of a terminal illness that leads to hospitalization. In Nowicki's institute at Lemberg 23 cases of rhinoscleroma were encountered within thirty-six years in a total of 31,962 necropsies. The disease may be the cause of sudden death through asphyxia or through hemorrhage complicating tracheotomy. Nowicki included in his series 8 cases of this type from the local medicolegal institute. Males and females were equally affected. Most of the cases occurred in young persons; 5 occurred in the age period from 11 to 20 years, and 17 in the decade from 21 to 30 years. The process was not limited to any particular portion of the upper respiratory tract. The larynx was most often involved, but usually in association with the nose, trachea and primary bronchi. Four anatomic forms are described: nodose, tuberous, diffuse and cicatricial. The essential features of the 31 cases are presented in tabular form.

O. T. SCHULTZ. [ARCH. PATH.]

Society Transactions

GERMAN OTOLARYNGOLOGICAL SOCIETY

Dresden, June 1-3, 1933

ZEITSCHRIFT FÜR HALS-, NASEN- UND OHRENHEILKUNDE **34**:129, 1933

ABSTRACTED BY ALFRED LEWY, M.D.

(Concluded from page 406)

SIGNIFICANCE OF HEMATOGENOUS INFECTION IN TUBERCULOSIS OF THE EAR AND OF THE UPPER AIR PASSAGES, WITH SPECIAL REFERENCE TO EXPERIMENTAL EVIDENCE. THEISSING, Bonn.

Tuberculosis of the ear and of the upper air passages is today considered not as a local infection but from the general immunobiologic standpoint and with reference to allergic manifestations.

Theissing discusses only tuberculosis of the ear and of the nasal passages. This occurs practically only during the generalized stage of tuberculosis, when the immunity of the organism is at its height, or in the tertiary stage with a localized lesion, and its development is possible, therefore, only when the local cellular resistance is reduced by either exogenous or endogenous causes.

In order to study the changes in the ear, Theissing injected tubercle bacilli into the carotid artery of twenty rabbits and twelve guinea-pigs, using for the rabbits a fine emulsion of pure cultures in sodium oxalate solution and for the guinea-pigs a coarse emulsion. The rabbits showed tuberculous changes in various viscera but in only one case in the ear. In two of the twelve guinea-pigs characteristic lesions were found in the middle ear.

Tuberculous changes in the nose were found in only two of nine rabbits into which a fine emulsion had been injected. However, all of the nine guinea-pigs inoculated with a coarse emulsion showed specific lesions in the nose. These lesions occurred in the bone simultaneously with and in some cases before the lesions in the mucosa.

In drawing conclusions it must be borne in mind that these experiments were made in healthy animals the immunity status of which had not been altered by general tuberculous infection or allergic conditions induced thereby. Moreover, no attention was given to the possible effect of pneumatization on the infective process.

IMPAIRMENT OF FUNCTION OF THE MUSCULATURE OF THE VOCAL CORDS. DR. HERZOG, Münster.

The author considers two questions: (1) the function of the posterior crico-arytenoid muscle and (2) the cause of the median position of the vocal cord.

He questions that the posterior crico-arytenoid muscle begins its function at the beginning of abduction and claims that the relaxation of the adductor muscles plus the muscle tone maintained by the sympathetic nerve and the elasticity of the tissues account for the median position. The abductor muscles are responsible for the wide open excursion of the cord.

He rejects Hajek's statement that the median position is due to contracture of the unopposed adductor muscles, as this does not occur elsewhere in the body where a movable joint is involved.

He describes a case of hypopharyngeal carcinoma in which the progressive gradual limitation of movement of the cord could be studied.

DEVELOPMENT OF CHOLESTEATOMA AFTER ANTROTOMY. DR. STEUER, Rostock.

Steurer describes several causes of the development of cholesteatoma after antrotomy:

1. In cases of persistent postauricular opening for which curettage is done, the failure to remove all squamous epithelium or the carrying in of some to the depths.

2. After apparent healing of the wound left by an operation for mastoiditis, dipping in of Shrapnell's membrane, possibly incited by the operative irritation, especially when separation of the soft parts of the canal was necessary, or perhaps spontaneously developed.

3. Ingrowing of epithelium through a fistula or a rupture of the external canal or through an operative opening thereof necessitated by these complications.

In case of delayed healing of a postauricular wound, if biopsy of deeper-lying granulation tissue shows the presence of squamous epithelium, reoperation should be preferred to simple curettage. A fetid odor in a poorly healing wound suggests the development of cholesteatoma, especially if a posterosuperior perforation or a perforation of Shrapnell's membrane appears. This is more likely to occur in a poorly pneumatized mastoid.

When cholesteatoma develops after simple antrotomy radical operation should not be delayed too long, as the condition may rapidly advance to cerebral involvement from the operative cavity.

THROMBOSIS OF THE SUPERIOR VENA CAVA. DR. MANN, Dresden. (Abstracted by DR. CARL CHRISTOPH.)

Thrombosis of the superior vena cava is extremely rare. Mann reports a case in which the condition has remained healed for over thirty years.

The patient, now 70 years old, was first seen thirty years ago. He had a terrific edema of the head, neck and chest and later of the arms. He sat for weeks in a chair, the colossal arms resting on small tables. He also had marked cyanosis, dyspnea and attacks of choking and was at times unconscious for hours. When given diuretics, he became rid of the edema, and at the same time collateral circulation was established. The patient is well and able to work although he cannot bend over. Although other cases of thrombosis of the superior vena cava have been reported, this case is unique as regards cure and duration of life.

LARYNGOCELE IN MAN AND ITS OPERATIVE TREATMENT. DR. ZANGE, Jena. (Abstracted by DR. CARL CHRISTOPH.)

Laryngocele in man is an outgrowth of the appendix ventriculi Morgagni which appears as a blind pouch, often with several finger-like projections developing upward and rarely downward in the direction of the hyoid bone and the base of the tongue.

Zange divides laryngocele into internal, external and combined. He also mentions a new type, pseudocombined laryngocele, the outer part of which has been brought about by stretching and pushing aside of the thyrohyoid membrane.

A new operative technic is given for internal, congenital internal and combined laryngocele. It is based on the anatomy and development of laryngocele and consists mainly of severing the thyrohyoid membrane at the hyoid bone and turning down the flap. In cases of external laryngocele the sac is removed through the thyrohyoid membrane in the old way.

RARE DISEASES OF THE TYMPANUM AND OF THE MIDDLE EAR. DR. BEYER, Berlin. (Abstracted by DR. CARL CHRISTOPH.)

Beyer mentions certain unusual conditions found in the drum and in the middle ear which are often wrongly diagnosed:

1. Encapsulated exudates in the region of the umbo, appearing first red and then yellow, often mistaken for syphilitic periostitis of the handle of the malleus.

2. Periostitis of the canal wall with redness and vascularization of the drum, which may be mistaken for a diphtheritic membrane.

3. Marked thickening of the tympanum due to fungi (Aspergillus), causing obliteration of the landmarks (the area is often incised, and mastoidectomy is even performed).

4. Calcium deposits and exostoses on the promontory seen through a thin membrane (relatively rare).

5. Splinters of bone forced into the middle ear through the antrum during a mastoidectomy, which are mistaken for pieces of the incus fractured by a fall and removed by incision.

6. Fractures of the malleus due to injury (rare).

7. Hematoma of the tympanum caused by a blow on the chin or the temple.

8. Angiofibroma of the middle ear.

9. Angioma of the middle ear (two forms, one bilateral).

LONGITUDINAL FRACTURE OF THE TEMPORAL PYRAMID WITH INJURY OF THE INNER EAR. DR. BROCK, Erlangen.

After describing the characteristic lesions produced by both longitudinal and transverse fractures of the petrosa, the latter of which usually involve the inner ear while the former do not, Brock reports a case, well illustrated by sections, in which a longitudinal fracture caused death from meningitis eight days later.

The line of fracture ran from above forward and medially along the upper border of the pyramid, varying slightly from the usual course and involving the upper lip of the internal auditory meatus. This was joined by another fracture of the labyrinth itself, parallel to the posterior surface of the pyramid, through the internal auditory meatus, vestibule, basal coil of the cochlea and oval and round windows.

LATE MENINGITIS AFTER FRACTURE OF THE LABYRINTH. DR. BROCK, Erlangen.

Brock reports the case of a 26 year old man in whom fatal meningitis developed fifteen years after a fracture involving the labyrinth. On his admission to the hospital for treatment of meningitis it was found that the right labyrinth was insensitive to the caloric test. Histopathologic examination post mortem revealed evidence of the old fracture and of old inflammation of the middle ear but no signs of recent inflammation of the middle ear. An inactive area of otosclerosis was discovered near the oval window of the uninjured ear. The case is important from the standpoint of legal medicine.

EPIDEMIOLOGIC INVESTIGATIONS OF THE BACTERIAL FLORA OF THE UPPER RESPIRATORY TRACT IN A WARD OF THE HEIDELBERG THROAT, NOSE AND EAR CLINIC (WITH SPECIAL REFERENCE TO POSTOPERATIVE ANGINA). DR. WIRTH and DR. BRANDER, Heidelberg.

After listing the incidence of Streptococcus haemolyticus, Pneumococcus, Bacillus capsulatus, Staphylococcus, Streptococcus viridans and Bacillus coli and considering their relation to postoperative angina, the authors conclude that the presence of Str. haemolyticus has a definite relationship to postoperative complications and that carriers of this organism should be carefully sought and excluded from the wards of hospitals as their presence is a menace to all other patients especially to noncarriers, who are less immune than carriers. The authors endorse the recommendations of others that patients undergoing operations on the upper respiratory tract belong in private rooms and not in wards.

EXPERIMENTAL INVESTIGATIONS OF SHADOWS OF FOREIGN BODIES IN THE LUNGS. DR. HERRMANN, Giessen.

Herrmann conducted a series of experiments on dogs by inserting foreign bodies in the lungs and making roentgenographic and histopathologic studies after various intervals. Partial and total obstruction was tried and also valvelike closure. The investigations indicated that the early appearance of a shadow in

the lung is due to capillary congestion, and this explans its early subsidence after removal of the foreign body. Valvelike obstruction produced at first a greater air content below the obstruction, with displacement of the heart toward the opposite side. Complete obstruction caused greater density, with pulling of the heart toward the affected side. The early density is caused by the filling of the capillaries, which is followed by transudation of serum into the alveoli.

TREATMENT OF PULMONARY TUBERCULOSIS BY INHALATION OF SERUM. DR. SPIESS, Frankfort-on-Main.

Spiess has used from 2 to 5 cc. of various serums by inhalation from a nebulizer to combat the mixed infection which accompanies tuberculosis. A flavoring made of caraway seed is used to overcome the disagreeable taste and smell. That such serums are absorbed by inhalation he proved by titrating the venous blood against tetanus toxin after inhalation of the antitoxin. He believes that direct application of serums in this way has therapeutic value, but he is not yet prepared to report his results.

OPERATIVE TREATMENT OF ACUTE INFECTION OF THE FRONTAL SINUSES. DR. TONNDORF, Dresden.

For acute frontal sinusitis associated with periostitis of the orbit or other evidence of spread to adjacent tissues which does not yield to more conservative measures, Tonndorf advises drainage by making a small incision at the inner angle of the orbit and a small opening in the bone at the junction of the front wall and the floor of the sinus and inserting a small rubber tube. The tube must not touch the mucosa of the posterior wall, and all the mucosa should be guarded against trauma. In cases of intracranial invasion, of course, he makes a radical opening (Ridell's operation).

DEVELOPMENT OF NASAL POLYPI. DR. MITTERMAIER, Freiberg.

Mittermaier investigated the mineral content of the nasal secretions, the blood and the nasal mucosa in cases of nasal polypi, one of the methods used being cryoscopy. He concluded that osmotic hypertonia is the most important factor and that the next is a preedemic state of the mucosa, which is metabolic or constitutional and also dependent on the mineral content.

GAS PHLEGMON AS A SEQUEL TO PERITONSILLAR ABSCESS. DR. REUTER, Coblenz.

Reuter states that he found no similar case previously reported in the literature. A man, aged 32, following a peritonsillar abscess had a swelling involving the whole right side of the face. Wide incision (external) released foul-smelling pus and serum. A large swelling in the mouth was incised, yielding coffee-colored foul pus. Tampons wet with isocytl hydrocupreine dihydrochloride (vucin) were applied. The swelling extended to the temporal region and behind the ear. These regions were incised widely. The tissues were greenish black and there were gas bubbles in the secretion. The wounds were dressed with tampons wet with surgical solution of chlorinated soda, and isocytl hydrocupreine dihydrochloride (vucin) was injected into the surrounding tissues. The patient also received two intravenous injections of "detoxin," daily, which were well born. After a stormy course, he recovered. It is not known whether the peritonsillar abscess or carious teeth were the source of the infection.

IMMUNITY IN INFLAMMATORY AND SUPPURATIVE DISEASES OF THE TONSILS. DR. GANGL-BATTIG, Graz.

The investigation is based on the number of phagocytes in various stages of inflammatory and suppurative diseases of the tonsils, which is taken as the index of immunity.

In peritonsillar abscess the height of immunity is practically at the height of the disease and sinks rapidly.

In inflammatory angina the number of phagocytes may be subnormal, slowly returning to normal with recovery.

Gangl-Battig believes that the fear of tonsillectomy during the height of the disease in cases of peritonsillar abscess is unfounded. In cases of other anginas it is better to wait five weeks before performing tonsillectomy.

FURTHER ANIMAL EXPERIMENTATION IN THE THERAPY OF SUPPURATIVE MENINGITIS. DR. JUNG, Breslau.

Various methods of treatment of virulent infections were studied:

Methenamine was administered to thirteen rabbits coincidentally with infection with streptococcic meningitis; all died. Six animals received methenamine one day before infection; one lived. Nine received methenamine two or more days before infection; five lived.

An acridine dye containing arsenic was given intravenously in doses of 25 mg. per kilogram to thirty rabbits. Twenty recovered. This is the best result that the author has ever seen. No ill effects were noted. He also reports one case of clinical meningitis in which the patient recovered after use of this drug, but he does not state whether or not the spinal fluid contained viable bacteria. This and the fact that the patient had an abscess of the brain which was later drained cloud the evidence seriously.

INVESTIGATIONS OF THE LABYRINTHINE PRESSURE. DR. KOBRAK, Münster.

Previous investigations by Kobrak concerned measurements of the labyrinthine pressure of rabbits after instillations of nicotine into the tympanic cavity, which caused contractions of the intrinsic muscles of the ear. The bulla was opened and a capillary tube inserted into the basal coil of the cochlea. Measurements were made of the movements of the capillary meniscus. The author also refers to the work of Krassnig, who dropped cocaine into the tympanic cavity through a perforation in the membrana tympani, inducing disturbances in hearing and Ménière's symptom complex, both of which are explainable on the basis of action of the intrinsic muscles.

Kobrak distinguishes between static changes in pressure, that is, slow ones, such as those induced pharmacologically, and dynamic changes, such as are induced by sounds. The question of the patency of the aqueduct necessitates simultaneous taking of the intracranial pressure. He trephined the skull and recorded the fluctuations in intracranial pressure simultaneously with the movements of the capillary meniscus on an optical kymograph, which showed that the fluctuations in intracranial pressure were of a different phase from those of labyrinthine pressure. The meniscus was also observed under a magnification of 70 diameters.

The results of this investigation indicate that the more rapid the changes in pressure the less the mass movement of the labyrinthine fluid. In terms of hearing, this is interpreted to mean that when the movement is sufficiently slow to permit equalization there is no perception of sound, as there is no stimulation of the basilar membrane. Perception of sound takes place only when the majority of the movements of the stapes are not transposed into mass movement but affect the inner ear as changes in pressure. Herewith is approached the concept of the threshold of hearing for low tones. This raises the question of the effect of the relationship of cranial to labyrinthine pressure and the effect of changes in the permeability of the canals, so that certain frequencies which ordinarily stimulate the basilar membrane may under these changed conditions fail to do so. This may also affect high tones. Conversely the question is raised as to the influence on hearing, in the presence of a patent aqueduct, of changes in intracranial pressure. The tests indicate that there is such an influence, but details are not entered into at this time except for the statement that measurement of the reflex movement of the tensor tympani in response to tones was not measurably influenced by moderate changes in intracranial pressure and that probably such changes as are transmitted to the labyrinthine fluid in daily life do not influence the hearing under ordinary circumstances.

Book Reviews

Archiv und Atlas der normalen und pathologischen Anatomie in typischen Röntgenbildern. Die Krankheiten der Nasennebenhöhlen und des Ohres im Röntgenbild. By Priv.-Doz. Dr. Med. Richard Mittermaier, Oberarzt der Klinik, Universitätsklinik für Hals-Nasen-Ohrenkrankheiten, Freiburg. Price, unbound, 25 marks; bound, 27 marks. Pp. 141, with 213 illustrations. Leipzig: Georg Thieme, 1934.

This is a substantial contribution consisting of a 141 page atlas presenting the roentgen findings in many diseases of the paranasal sinuses and of the ear and mastoid. There are 213 illustrations, each accompanied by an illuminative description. In many cases these are also accompanied by line tracings explaining the anatomy and identifying the lesions. A considerable number of the rarer tumors of these parts are shown. For many of these the author makes free use of vertical views. The reproduction of the roentgenograms is excellent.

Directory of Otolaryngologic Societies *

FOREIGN

COLLEGIUM OTO-RHINO-LARYNGOLOGICUM AMICITIÆ SACRUM

President: Prof. Gunnar Holmgren, Karolinska Mediko Kirurgiska Institut, Stockholm, Sweden.
Secretary: Prof. Dr. C. E. Benjamins, Verlengde Heereweg, 143, Groningen, The Netherlands.
Place: Stockholm, Sweden. Time: September 2-5, 1934.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SECTION ON LARYNGOLOGY, OTOLOGY AND RHINOLOGY

Chairman: Dr. John J. Shea, 1018 Madison Ave., Memphis, Tenn.
Secretary: Dr. John W. Cormack, 23 E. Ohio St., Indianapolis.
Place: Atlantic City, N. J. Time: June 1935.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. J. M. Wheeler, 30 W. 59th St., New York.
President-Elect: Dr. Wells P. Eagleton, 15 Lombardy St., Newark, N. J.
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Place: Chicago. Time: Sept. 9-14, 1934.

AMERICAN BRONCHOSCOPIC SOCIETY

President: Dr. W. F. Zinn, Medical Arts Bldg., Baltimore.
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AMERICAN LARYNGOLOGICAL ASSOCIATION

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AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

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Southern.—Secretary: Dr. Fletcher D. Wodward, P. O. Box 1685, University, Va.
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AMERICAN OTOLOGICAL SOCIETY

President: Dr. John R. Page, 127 E. 62d St., New York.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.

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* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

INDEX TO VOLUME 19

The asterisk (*) preceding the page number indicates an original article in the Archives. Subject entries are made for all articles. Author entries are made for original articles and society transactions. Book Reviews and Society Transactions are indexed under these headings in their alphabetical order under the letters B and S, respectively.

Abscess: See also under names of organs and regions
  hemorrhage from pharyngeal and peritonsillar abscess: report of cases; résumé of literature, and discussion of ligation of carotid artery, 128
  peritonsillar, gas phlegmon as sequel to, 749
  retropharyngeal abscess evacuator, *618
Acidosis, alterations in labyrinthine capsule of rabbit in, 402
Acne vulgaris and chronic eczema cured by tonsillectomy, 396
Adenoids; adenoid punch and new soft palate retractor, *66
  end-results of tonsil and adenoid operation in childhood and adolescence, 395
Advisory Board for Medical Specialties, 638
Agranulocytosis: See under Angina
Albrecht: Changes in cochlea in hereditary inner ear deafness, 404
Allan, W. B.: Nasopharyngeal fibroma, *216
Allergy: See Anaphylaxis and Allergy
American Board of Otolaryngology, examination, 295
Amniotic membrane, use as transplant following radical mastoidectomy, 109
Amusia: See under Music
Amygdalectomy: See Tonsillectomy
Amyloid, local amyloid disease of upper air passages; report of 5 cases, *439
Anaphylaxis and Allergy; allergy as related to otolaryngology and pediatrics, 399
  clinical analysis of 150 cases of allergy of nose and paranasal sinuses, 153
  serous meningitis of allergic nature, 519
Anesthesia, temporary blindness due to orbital anesthesia, 279
Angina, agranulocytosis; appearance of early pharyngeal lesion, 125
  agranulocytosis; extensive necrosis of intestinal tract in agranulocytosis, 280
  epidemiologic investigations of bacterial flora of upper respiratory tract with reference to postoperative angina, 748
  pectoris, treatment of angina pectoris and congestive heart failure by total ablation of thyroid; importance of laryngoscopic examination as means of preventing bilateral paralysis of vocal cords, *383
  Vincent's, arsphenamine treatment, 278
Antrum, cancer of, 282
  cancer of antrum and metaplasia, 742
  comparative clinical examinations of maxillary sinus, 106
  dentigerous cysts, report of 2 cases, *348
  development of cholesteatoma after antrotomy, 747
  injuries to teeth following operation on, 648
  instruments for radical operations on sinuses, *389
  sensory disturbances following radical operations on antrums with evaluation of vertical incision, *303
  transosseous vascular anastomoses between maxillary sinus and orbit in human fetus and in new-born, 647
  volume of maxillary sinus from physiologic and from pathologic standpoint, 105
Apparatus: See Instruments
Argyria: See under Silver
Arthritis, importance of roentgenologic examination of sinuses in chronic arthritis with special reference to cases in which sinuses are silent focus of infection, *23
Audition: See Hearing
Auditory Organ: See Ear

Babcock, W. W.: Plastic closure of laryngostomic fistulas and enlargement of lumen of trachea or larynx by implantation of chondrocutaneous flap, *585
Bacillus coli; aural infections from colon bacillus; report of case, *249
  otitis caused by Bacillus Friedlander, 640
Barth: Results of injection of parathormone in rats and guinea-pigs, with reference to temporal bone, 402
Baryecoia: See Deafness
Bast, T. H.: Function of utriculo-endolymphatic valve; 2 cases of ruptured saccules in children, *537
Beavis, J. O.: Local amyloid disease of upper air passages; report of 5 cases, *439
Beck, J. C.: Presidential address, 109
Berman, H. L.: Quinsy in young infant, *710
Berry, G.: Bilateral branchial cyst, 138
Beyer: Rare diseases of tympanum and middle ear, 747
Bifocals, extension head mirror link for surgeon wearing bifocal lenses, *620
Blindness, temporary, due to orbital anesthesia, 279
Blood pressure; labyrinth and circulatory reactions, 403
  throat manifestations of blood dyscrasias, 740
Bones, fragility; case of osseous fragility with cranial deformity and blue sclerae, 399

Book Reviews:
  Allgemeine und spezielle chirurgische Operationslehre; M. Kirschner, 651
  Archiv und Atlas der normalen und pathologischen Anatomie in typischen Röntgenbildern. Die Krankheiten der Nasennebenhöhlen und des Ohres im Röntgenbild; R. Mittermaier, 751
  Handbuch der biologischen Arbeits-Methoden: Part V. Herstellung und methodische Verwertung von Schallaufnahmen; Untersuchungsmethoden der Stimme und Sprache; E. Froschels, L. Hajek and D. Weiss, 295

Brain: See also Cerebellum
  abscess; acute frontal sinusitis with abscess of brain and meningitis, 528
  abscess; leaking brain abscess, 649
  puncture, cerebral (ventricular) hydrodynamic test for thrombosis of lateral sinus, *297
Brander: Epidemiologic investigations of bacterial flora of upper respiratory tract with reference to postoperative angina, 748
Brock: Late meningitis after fracture of labyrinth, 748
  Longitudinal fracture of temporal pyramid with injury of inner ear, 748
Bronchiectasis, bronchiectatic septic tank, 290
  unsuspected chronic bronchiectasis from inhalation of fragment of bone; unusual sequel to comminuted fracture of nasal bones, 649
Bronchus, foreign body (peanut) in, 283
  inflammatory tumors of bronchi, experimental and pathologic consideration, *1
  malignant disease, 278
  primary bronchiogenic carcinoma, 406
Browder, E. J.: Electrocoagulation of cavernous sinus to prevent thrombosis: report of successful case following carbuncle of nose, 149

Cahill, H. P.: Mastoid fracture with complications, 285
Simple mastoiditis with complications, 534
Calculi in submaxillary and sublingual glands and ducts, *318
Cancer: See also Esophagus, cancer; Larynx, cancer; Tumors; etc.
frequency of metastases of primary malignant tumors in field of otorhinolaryngology, 527
Carbuncle of nose, electrocoagulation of cavernous sinus to prevent thrombosis; report of successful case following carbuncle of nose, 149
Carotene, infection of accessory sinuses in vitamin A deficiency; rôle of carotene in infection of upper respiratory tract, 396
Cavernous sinus, electrocoagulation to prevent thrombosis; report of successful case following carbuncle of nose, 149
Cerebellum, tumor in region of vermis diagnosed by vestibular examination, 739
Cholesteatoma aural polyp containing cholesteatoma, (microscopic slides), 281
development of cholesteatoma after antrotomy, 747
of accessory sinuses, origin of, 648
Choanae: See Nose
Chordoma, spheno-occipital chordoma, 743
Christian-Schüller Syndrome: See Schüller-Christian Syndrome
Cilia, effects of drugs on ciliary activity of mucosa of upper respiratory tract, *55
Clerf, L. H.: Carcinoma of larynx; analysis of 58 cases with treatment by laryngofissure, *653
Peroral endoscopy, *253
Cochlea: See Ear, internal
Cold, hemisudation of face in paroxysms excited by cold and appearing after endonasal operation, 646
Coryza: See Rhinitis, vasomotor
Costen, J. B.: Agranulocytosis: appearance of early pharyngeal lesion, 125
Courville, C. B.: Fatal complications of otitis media with particular reference to intracranial lesions in series of 10,000 autopsies, *451
Cranium, case of osseous fragility with cranial deformity and blue sclerae, 399
fatal complications of otitis media with particular reference to intracranial lesions in series of 10,000 autopsies, *451
peritubal cancers and their endocranial propagation, 744
spheno-occipital chordoma, 743
temporal bone in cases of increased intracranial pressure, 642
Cummings, G. O.: Treatment and management of nontuberculous pulmonary abscess with reference to series of 25 consecutive cases, *684
Cysts, branchial, bilateral, 138
dentigerous cysts of antrum, report of 2 cases, *348
Dermoid: See Dermoid cyst
laryngeal, in new-born, 396, *590

Dandy, W. E.: Cerebral (ventricular) hydrodynamic test for thrombosis of lateral sinus, *297
Davis, S. W.: Oxygen therapy in acute respiratory obstruction in children, *387
Deafmutism, development of speech in deaf and dumb, 280
Deafness: See also Hearing
changes in cochlea in hereditary inner ear deafness, 404
chronic progressive deafness, including otosclerosis and diseases of inner ear, *712
clinical study of severe deafness in adults, 122
effect of ultra-acoustic sound waves on deafened ear, 403
high frequency sound waves in treatment of chronic baryecoia, 392
injury to ears due to noise and vibration, 100
otogenous subdural abscess in case of apparent traumatic deafness; contribution to theory of concussion of labyrinth, 518
Deafness—Continued
therapeutic effect of short sound waves on ear, 273
Dentigerous Cysts: See Cysts
Dermoid cyst of nasal dorsum, *67
Diathermy: See under Tonsillitis; etc.
Dickie, J. K. M.: Chronic progressive deafness including otosclerosis and diseases of inner ear, *712
Diphtheria carriers in school, 644
laryngeal, suction in, 521
like organisms from nasopharynx, 103
Directory of otolaryngologic societies, 156, 296, 414, 536, 652, 752
Diverticulum, hypopharyngeal, *247
Dixon, O. J.: Retropharyngeal abscess evacuator, *618
Druss, J. G.: Geniculate ganglionitis (Hunt's syndrome); clinical features and histopathology, *574
Labyrinthitis and sinus thrombosis complicating suppuration of middle ear, *671
Periarteritis nodosa of temporal bone, *502
Dysphonia spastica; phonation with false vocal cords, dysphonia spastica and pharyngeal muscles, 104

Ear: See also Deafness; Hearing; and under names of special structures
absence; 7 prehistoric American skulls with complete absence of external auditory meatus, 272
atresia; anatomy and genesis of congenital atresia of ear, 517
auditory and neurologic sequelae consecutive to action of traumatizing telephonic noises, 737
auditory physiology of vestibule and hearing in fish, 640
changes in osseous capsule of internal ear in relation to histopathology of skeletal system, 274
comparative nitrogen content of secretion from middle ear in acute otitis media and in tubotympanic catarrh, 404
cupola in ampulla of pike's labyrinth, 739
infections from colon bacillus; report of case, *249
inner, changes in cochlea in hereditary inner ear deafness, 404
inner; chronic progressive deafness including otosclerosis and diseases of inner ear, *712
inner; longitudinal fracture of temporal pyramid with injury of inner ear, 748
inner; otogenous subdural abscess in case of apparent traumatic deafness; contribution to theory of concussion of labyrinth, 518
mechanism of fistula sign, 738
microscopic structure of auditory ossicles and its development, 516
Middle: See also Otitis media
middle: rare diseases of tympanum and of middle ear, 747
middle: reflex contractions of muscles of middle ear as hearing test in experimental animals, 114
middle, tuberculosis of, 393
morphologic picture of crista acustica during state of stimulation, 100
polyp containing cholesteatoma (microscopic slides), 281
radical operation through external auditory meatus, 519
rupture of suppurative cervical glands into external auditory canal, *610
small; 3 cases of microtia, 284
therapeutic effect of short sound waves, 273
tuberculosis; significance of hematogenous infection in tuberculosis of ear and of upper air passages, with reference to experimental evidence, 746
Eczema, acne vulgaris and chronic eczema cured by tonsillectomy, 396
Ehrlich's negative phase as contraindication for tonsillectomy, 740
Encephalitis, diagnosis of postencephalitic disturbances of speech, 396
Endocrine Glands; endocrine basis of otosclerosis, 273

Endoscopy, peroral endoscopy, *253
Epistaxis: See Nose, hemorrhage
Equilibrium: See also Nystagmus
experimental traumatic shock on equilibration apparatus in animals, 403
Ergosterol, experimental osteodystrophia fibrosa produced by overdosage of viosterol and its significance for otosclerosis, 402
Eschweiler: Development of fissures in labyrinthine capsule, 401
Esophagus cancer, metastatic, (microscopic slides), 281
diverticula, congenital, 280
diverticula of thoracic portion of esophagus, report of 42 cases, *508
partial thoracic stomach with short esophagus; 7 cases, 279
prophylactic mediastinotomy for perforating esophageal foreign bodies, *426
sections of esophagus, presentation of, 529
stenosis, complete, 284
Ethmoid bone, moving picture of external ethmosphenofrontal operation, 130
cavity, lesions of contents of orbit during endonasal curetting of ethmoid cavity; report of 2 cases, 742
sinus, new intranasal operation, *40
Ethmoiditis, acute, 105
in children, 398
Exophthalmos, relation to nasal sinus disease, 645
Eyelids, decompression of facial nerve; physiology of seventh and ninth nerves and movements of lids in facial paralysis, 137

Fabricant, N. D.: Sensory disturbances following radical operations on antrums with evaluation of vertical incision, *303
Face, incomplete facial hemiatrophy of sympathetic origin, 99
osteitis deformans of bones of, 120
Fenton, R. A.: Histopathology and clinical interpretation of experimental sinus disease, *183
Fibroma, nasopharyngeal, *216
Figi, F. A.: Sarcoma of larynx; report of 4 cases, 152
Fineman, S.: Importance of roentgenologic examination of sinuses in chronic arthritis with reference to cases in which sinuses are silent focus of infection, *23
Fishman, L. Z.: Prophylactic mediastinotomy for perforating esophageal foreign bodies; report of 3 unusual cases, *426
Fistula, mechanism of fistula sign, 738
plastic closure of laryngostomic fistulas and enlargement of lumen of trachea or larynx by implantation of chondrocutaneous flap, *585
repair of postauricular fistula following radical mastoidectomy, *616
Foreign Bodies, experimental investigations of shadows of foreign bodies in lungs, 748
in air and food passages; report based on 334 cases, 277
peanut in bronchus, 283
prophylactic mediastinotomy for perforating esophageal foreign bodies; report of 3 unusual cases, *426
Forman, J.: Contact allergic coryza, *367
Frackelton, R. J.: Acute mastoiditis with complications, 286
Mastoid fracture with complications, 285
Fred, G. B.: Acute frontal sinusitis with abscess of brain and meningitis, 528
Carcinoma of antrum, 282
Pansinusitis with orbital abscess and meningitis, 530
Freedman, L. M.: Treatment of angina pectoris and congestive heart failure by total ablation of thyroid; importance of laryngoscopic examination as means of preventing bilateral paralysis of vocal cords, *383
Frontal Bone, moving picture of external ethmosphenofrontal operation, 130
osteomyelitis of frontal bone, 531
Frontal Sinus: See also under Sinuses
acute frontal sinusitis with abscess of brain and meningitis, 528
Frontal Sinus—Continued
irrigation in treatment of disease of frontal sinus; anatomic clinical study of nasofrontal connections, *224
operative treatment of acute infection, 749
osteoma, 106
treatment of frontal sinusitis by external drainage, 648

Gangl-Battig: Immunity in inflammatory and suppurative diseases of tonsils, 749
Ganglion, Geniculate: See Geniculate Ganglion
Gas phlegmon as sequel to peritonsillar abscess, 749
Geniculate Ganglion; geniculate ganglionitis (Hunt's syndrome); clinical features and histopathology, *574
Gilbert, J. G.: Improved operative technic for suppuration of petrous apex, *699
Goedel: Comparative nitrogen content of secretion from middle ear in acute otitis media and in tubotympanic catarrh, 404
Goldman, I. B.: New nasal speculum, *618
Gradenigo's Syndrome: See under Otitis media
Grahe: Experimental traumatic shock of equilibration apparatus in animals, 403
Granuloma, progressive lethal granulomatous ulceration of nose, 523
Greenfield, S. D.: Etiology and pathology of paralysis of abducens nerve associated with sinus thrombophlebitis; report of case of thrombosis of lateral sinus and bilateral paralysis of abducens nerve; operation and recovery, *336

Hagens, E. W.: Anatomy and pathology of petrous bone based on study of 50 temporal bones, *556
Hansel, F. K.: Clinical analysis of 150 cases of allergy of nose and paranasal sinuses, 153
Harris, M. L.: Ligature carrier and tier, *68
Hart, V. K.: Oxygen therapy in acute respiratory obstruction in children, *387
Headache and pain in inflammation of nasal sinuses, 397
use of headband in treatment of symptomatic neuralgic headaches, 526
Hearing: See also Deafness
comparative quantitative hearing tests with *C* 5 tuning fork and *C* 5 and *C* 6 sound rods in persons with normal hearing and in persons with injury to auditory nerve, 272
functional tests, *70
recent advances in physiology of hearing, *201
test; reflex contractions of muscles of middle ear as hearing test in experimental animals, 114
testing hearing of preschool child, *514
tests; what is significance of Stenger test? 404
Heart, treatment of angina pectoris and congestive heart failure by total ablation of thyroid; importance of laryngoscopic examination as means of preventing bilateral paralysis of vocal cords, *383
Hemorrhage, throat manifestations of blood dyscrasias, 740
Herpes Zoster; cephalic zona, 743
Herrmann: Experimental investigations of shadows of foreign bodies in lungs, 748
Herzog: Impairment of function of musculature of vocal cords, 746
High frequency sound waves in treatment of chronic laryecola, 392
Holmes, E. M.: Carcinoma of antrum, 282
Simple mastoiditis with complications, 534
Honiss, J. R.: Abuse of powerful nasal oils, *252
Hunt's Syndrome: See Geniculate Ganglion
Hydrops, so-called hydrops tympani ex vacuo, 101
Hypopharynx: See Pharynx

Infant, new-born, laryngeal cysts in new-born, *590
transosseous vascular anastomoses between maxillary sinus and orbit in human fetus and in new-born, 647

Influenza, otorhinolaryngologic experiences in this year's epidemic of influenza, 642
Instrument, extension head mirror link for surgeon wearing bifocal lenses, *620
for radical operations on sinuses, *389
laryngostroboscope, *708
ligature carrier and tier, *68
new nasal speculum, *618
new soft palate retractor and adenoid punch, *66
retropharyngeal abscess evacuator, *618
Intestine, extensive necrosis of intestinal tract in agranulocytosis, 280
Irvine, R. S.: Use of tapering tube sutured in trachea to prevent aspiration during and after laryngectomy, *69
Israel, S.: Chemical composition of sinus pus, 141

Jackson, C.: Bronchiectatic septic tank, 290
Is it advisable to treat posttuberculous cicatricial stenosis of larynx? 288
Jackson, C. L.: Bronchiectatic septic tank, 290
Jason, R. S.: Pathologic changes in human palatine tonsil; correlation with clinical findings, *600
Johnson, H. P.: Rise in temperature after mastoidectomy, 111
Temperature after mastoidectomy; study of 100 cases, *660
Jung: Further animal experimentation in therapy of suppurative meningitis, 750

Kazanjian, V. H.: Three cases of microtia, 284
Kelley, V. J.: Acute mastoiditis with complications, 286
Kirch, W.: Tumors of nose and throat, *621
Kleinfeld, L.: Laryngeal cysts in new-born, *590
Myoblastoma of larynx; report of case, *551
Kobrak: Investigations of labyrinthine pressure, 750
Kopetzky, S. J.: Suppuration of petrosal pyramid; problems concerned with anatomy, pathology and surgical therapy, 143
Krainz: Alterations in labyrinthine capsule of rabbit in acidosis, 402

Labyrinth: See also Equilibrium; Reflex
alterations in labyrinthine capsule of rabbit in acidosis, 402
and circulatory reactions, 403
certain particulars of labyrinthine reactions in 3 cases of traumatic temporal lesions, 99
complications in acute and chronic otitis media, 642
cupola in ampulla of pike's labyrinth, 739
development of fissures in labyrinthine capsule, 401
function of cupola in ampullae of canals of labyrinth, 403
late meningitis after fracture of labyrinth, 748
pressure, investigations of, 750
reflexes in guinea-pigs after removal of otoliths by centrifugation, 739
roentgen examination in chronic otitis, 394
vasomotor syndrome, 738
Labyrinthitis and sinus thrombosis complicating suppuration of middle ear, *671
Lange: Histogenesis of otosclerosis, 401
Langenbeck: What is significance of Stenger test? 404
Larsell, O.: Histopathology and clinical interpretation of experimental sinus disease, *183
Laryngectomy, use of tapering tube sutured in trachea to prevent aspiration during and after laryngectomy, *69
Laryngitis, chronic diseases of paranasal sinuses and their relation to chronic laryngitis with bronchiectasis and asthma, 524
subglottica, etiology of, 276
Laryngocele in man and its operative treatment, 747
Laryngoscopy, stroboscopy in laryngoscopy, 104
Laryngostroboscope, *708
Larynx, amyloid disease of upper air passages, local; report of 5 cases, *439
atresia, congenital, 276
Larynx—Continued
bilateral paralysis of posterior crico-arytenoid muscles, Wittmaack's operation for, 527
cancer of larynx; analysis of 58 cases with treatment by laryngofissure, *653
cancer, partial resection of larynx in, 520
cancer, pedunculated, 645
cysts; clinical and anatomicopathologic study of congenital laryngeal cysts in new-born, 396
cysts in new-born, *590
diphtheria, suction in, 521
myoblastoma, report of case, *551
plastic closure of laryngostomic fistulas and enlargement of lumen of trachea or larynx by implantation of chondrocutaneous flap, *585
sarcoma, report of 4 cases, 152
stenosis; is it advisable to treat posttuberculous cicatricial stenosis of larynx? 288
surgical treatment of congenital laryngeal diaphragm, 104
tuberculosis, *195
tuberculosis, treatment by laryngeal quartz lamp of Cemach, 645
Lederer, F. L.: Neurocytoma originating from right stellate ganglion, 406
Pathogenesis and end-results of dural sinus thrombosis, 410
Prophylactic mediastinotomy for perforating esophageal foreign bodies; report of 3 unusual cases, *426
Leshin, N.: Functional tests of hearing, *70
Lierle, D. M.: Effects of drugs on ciliary activity of mucosa of upper respiratory tract, *55
Loebell: Functional anatomy of human temporal bone, 401
Lorente de Nó, R.: Reflex contractions of muscles of middle ear as hearing test in experimental animals, 114
Love, A. A.: Dentigerous cysts of antrum; report of 2 cases, *348
Instruments for radical operations on sinuses, *389
New soft palate retractor and adenoid punch, *66
Lukens, C.: Extension head mirror link for surgeon wearing bifocal lenses, *620
Lung, abscess, treatment and management of nontuberculous abscess with reference to series of 25 consecutive cases, *684
cancer, primary, bronchiogenic; incidence, pathogenesis and diagnosis, 406
cirrhosis due to aspiration of liquid petrolatum, 108
foreign bodies, experimental investigations of shadows of foreign bodies in lungs, 748
Lurie, M. H.: Otitis media, mastoiditis, trigeminal neuralgia and meningitis, 287
Lymph Nodes, cervical; rupture of suppurative cervical glands into external auditory canal, *610
extreme adenopathy, 519
Lyons, H. R.: Use of amniotic membrane as transplant following radical mastoidectomy, 109

Macfarlan, D.: Testing hearing of preschool child, *514
McGillicuddy, O. B.: Hypopharyngeal diverticulum, *247
McMahon, B. J.: Spread and extension of particulate matter in nasal mucous membrane of rabbit, 118
McNally, W. J.: Recent advances in physiology of hearing, *201
Mann: Thrombosis of superior vena cava, 747
Mark: Labyrinth and circulatory reactions, 403
Mastoid cells, arrangement in relation to sigmoid portion of transverse sinus, *326
fracture with complications, 285
vein, surgical importance in infected lateral sinus thrombosis, 117
Mastoidectomy, repair of postauricular fistula following radical mastoidectomy, *616
rise in temperature after, 111
temperature after study of 100 cases, *660
use of amniotic membrane as transplant following radical mastoidectomy, 109

Mastoiditis: See also Otitis media
acute, with complications, 286
otitis media, mastoiditis, trigeminal neuralgia and meningitis, 287
simple, with complications, 534
Maxillary Antrum: See Antrum
Sinus: See Antrum
Maybaum, J. L.: Geniculate ganglionitis (Hunt's syndrome); clinical features and histopathology, *574
Periarteritis nodosa of temporal bone, *502
Mediastinotomy, prophylactic mediastinotomy for perforating esophageal foreign bodies; report of 3 unusual cases, *426
Meltzer, P. E.: Mastoid cells; their arrangement in relation to sigmoid portion of transverse sinus, *326
Ménière's Disease: See Vertigo, aural
Meningitis, acute frontal sinusitis with abscess of brain and meningitis, 528
animal experimentation in therapy of suppurative meningitis, 750
aseptic otogenous serous meningitis, 99
is endolumbar irrigation with physiologic solution of sodium chloride in meningitis without danger? 641
late, after fracture of labyrinth, 748
otitis media, mastoiditis and trigeminal neuralgia, 287
pansinusitis with orbital abscess and meningitis, 530
serous, of allergic nature, 519
serous, with cerebellar syndrome during subsidence of catarrhal otitis, 516
Microtia: See Ear, small
Mirror link, extension head mirror link for surgeon wearing bifocal lenses, *620
Mittermaier: Development of nasal polypi, 749
Monson, L. P.: Argyria nasalis; report of case, *582
New intranasal operation on ethmoid sinus, *40
Moore, P. M.: Effects of drugs on ciliary activity of mucosa of upper respiratory tract, *55
Mosher, H. P.: Microscopic slides, 281
Presentation of sections of esophagus, 528
Mowrer, O. H.: Influence of "excitement" on duration of postrotational nystagmus, *46
Mucous membrane, effects of drugs on ciliary activity of mucosa of upper respiratory tract, *55
Music, traumatic amusia; report of case, 520
Myerson, M. C.: Electrocoagulation of cavernous sinus to prevent thrombosis: report of successful case following carbuncle of nose, 149
Improved operative technic for suppuration of petrous apex, *699
Myoblastoma of larynx, report of case, *551

Nasopharynx, carcinoma, 739
diphtheria-like organisms from nasopharynx, 103
fibroma, *216
peritubal cancer and their endocranial propagation, 744
plasmacytoma of nose and nasopharynx, *311
roentgen treatment of recurrent inflammation of nasopharynx, 395
Nauck: Functional anatomy of human temporal bone, 401
Nerve, abducens; etiology and pathology of paralysis of abducens nerve associated with sinus thrombophlebitis; report of case of thrombosis of lateral sinus and bilateral paralysis of abducens nerve; operation and recovery, *336
acoustic, neurinoma of acoustic nerve, 100
glossopharyngeal, neuralgia, 399
nasal nerve syndrome, 277
nasal, new nasal syndrome and its latent forms, 525
optic, bilateral atrophy associated with unilateral sphenoid pneumosinus, 741
Paralysis: See under Paralysis
Neuralgia of glossopharyngeal nerve, 399
otitis media, mastoiditis, trigeminal neuralgia and meningitis, 287
Neuralgia—Continued
use of headband in treatment of symptomatic neuralgic headaches, 526
Neurinoma of acoustic nerve, 100
Neuritis, is "retrobulbar neuritis" as often due to disease of nasal accessory sinuses as is generally held? 741
retrobulbar, and disease of nasal accessory sinus, 521
rhinogenous retrobulbar neuritis, 106
Neurocytoma originating from right stellate ganglion, 406
Neuroretinitis of nasal origin, 741
New, G. B.: Osteitis deformans of bones of face, 120
Tumors of nose and throat, *621
New-Born Infant: See Infant
Nicholas, H. O.: Chemical composition of sinus pus, 141
Nielsen, J. M.: Fatal complications of otitis media with particular reference to intracranial lesions in series of 10,000 autopsies, *451
Nose: See also Nasopharynx
abuse of powerful nasal oils, *252
Accessory Sinuses: See under Sinuses
allergy of nose and paranasal sinuses, clinical analysis of 150 cases of, 153
anterior turbinate bone in man, 647
argyria nasalis, report of case, *582
barrier function of nose, 107
cilia; effect of temperature on nasal cilia, *607
comparative anatomy of primate nose, 648
degenerative changes of nose in atrophic conditions, 398
dermoid cyst of nasal dorsum, *67
granulomatous ulceration of nose, progressive, lethal, 523
hemisudation of face in paroxysms excited by cold and appearing after endonasal operation, 646
hemorrhage (epistaxis), 532
nasal nerve syndrome, 277, 525
neuroretinitis of nasal origin, 741
perforating ulcer of septum, genesis of, 526
plasmacytoma of nose and nasopharynx, *311
plastic surgery, 524
polypi, development of, 749
polypi; relation of nasal polypi to hypertrophic inflammation of nasal sinuses, 398
polyps, choanal, 742
septum; development, structure and changes in form of human nasal septum in fetal period, 105
spread and extension of particulate matter in nasal mucous membrane of rabbit, 118
tuberculosis; significance of hematogenous infection in tuberculosis of ear and of upper air passages, with reference to experimental evidence, 746
tumors of nose and throat, *621
unsuspected chronic bronchiectasis from inhalation of fragment of bone: unusual sequel to comminuted fracture of nasal bones, 649
Nystagmus, does spontaneous nystagmus occur in normal persons? 640
influence of "excitement" on duration of postrotational nystagmus, *46
mechanism of fistula sign, 738
quantitative studies of postrotatory nystagmus, 394
quantitative determination of labyrinthine function with total postrotatory nystagmus; significance in otitis interna, 517
spontaneous, directed alternately to right and to left, 392

Oils, abuse of powerful nasal oils, *252
Orbit, lesions of contents of orbit during endonasal curetting of ethmoid cavity, report of 2 cases, 742
pansinusitis with orbital abscess and meningitis, 530
pathogenesis and clinical picture of polysinusitis with orbital complications, 647
temporary blindness due to orbital anesthesia, 279

Orbit—Continued
transosseous vascular anastomoses between maxillary sinus and orbit in human fetus and in new-born, 647
Osteitis deformans of bones of face, 120
deformans, symptomatology of, 650
fibrosa, experimental osteodystrophia fibrosa produced by overdosage of viosterol and its significance for otosclerosis, 402
Osteoma of frontal sinus, 106
Osteomyelitis of frontal bone, 531
of sphenoid bone, etiology of, 647
Otitis caused by Bacillus Friedlander, 640
interna, quantitative determination of labyrinthine function with total postrotatory nystagmus; significance in otitis interna, 517
Media: See also Mastoiditis
media, acute and chronic, with endocranial complications and pregnancy, 102
media, blood infection from otitis media; analysis of 63 cases, 516
media, comparative nitrogen content of secretion from middle ear in acute otitis media and in tubotympanic catarrh, 404
media, fatal complications of otitis media with particular reference to intracranial lesions in series of 10,000 autopsies, *451
media in scarlet fever, 102
media, labyrinthitis and sinus thrombosis complicating suppuration of middle ear, *671
media, mastoiditis, trigeminal neuralgia and meningitis, 287
media, paralysis of abducens in acute otitis media, 641
media, roentgen examination of labyrinth in chronic otitis, 394
media, roentgenology in Gradenigo's syndrome, report of case, 392
media, severe labyrinth complications in acute and chronic otitis media, 642
media, Streit operative approach to petrous tip in Gradenigo symptom complex, report of case, 405
media, treatment of chronic otitis with medicated foam-producing pencils, 101
serous meningitis with cerebellar syndrome during subsidence of catarrhal otitis, 516
Otolaryngologic societies, directory of, 156, 296, 414, 536, 652, 752
Otoliths, labyrinth reflexes in guinea-pigs after removal of otoliths by centrifugation, 739
Otosclerosis and alteration of labyrinthine capsule, 401
chronic progressive deafness including otosclerosis and diseases of inner ear, *712
endocrine basis, 273
experimental osteodystrophia fibrosa produced by overdosage of viosterol and its significance for otosclerosis, 402
heredity and pregnancy in, 640
histogenesis, 401
Oxygen therapy in acute respiratory obstruction in children, *387
Ozena: See Rhinitis

Palate, new soft palate retractor and adenoid punch, *66
Paralysis, associated paralysis of vocal cord, 644
facial; decompression of facial nerve: physiology of seventh and ninth nerves and movements of lids in facial paralysis, 137
of abducens in acute otitis media, 641
Pearlman, S. J.: Hemorrhage from pharyngeal and peritonsillar abscess: report of cases; résumé of literature, and discussion of ligation of carotid artery, 128
Periarteritis nodosa of temporal bone, *502
Perlman, H. B.: Lingual thyroid gland, *594
Peroni, A.: Inflammatory tumors of bronchi; experimental and pathologic consideration, *1
Perspiration: See Sweat and Sweat Glands
Perwitzschky: Effect of ultra-acoustic sound waves on deafened ear, 403
Petrolatum, liquid, cirrhosis of lung due to aspiration of, 108
Petrous Bone: See Temporal Bone
Pharynx, hemorrhage from pharyngeal and peritonsillar abscess; report of cases; résumé of literature and discussion of ligation of carotid artery, 128
hypopharyngeal diverticulum, *247
Phlegmon, gas, as sequel to peritonsillar abscess, 749
Phonation: See under Voice
Photography, new adaptation of x-ray prints and slides (demonstration), *704
Plasmacytoma of nose and nasopharynx, *311
Pneumatization of temporal bone, 172
Pollock, F. J.: Plasmacytoma of nose and nasopharynx, *311
Polyps, choanal, 742
from vocal cord (microscopic slides), 281
nasal, development of, 749
postnasal, large, in child, 277
Powell, L. S.: Dermoid cyst of nasal dorsum, *67
Laryngostroboscope, *708
Pregnancy and heredity in otosclerosis, 640
Proetz, A. W.: Effect of temperature on nasal cilia, *607
Puerperal infection, identity of course of posttonsillitis sepsis and puerperal sepsis, 643

Quartz lamp of Cemach in laryngeal tuberculosis, 645
Quincy, J. E.: Acute frontal sinusitis with abscess of brain and meningitis, 528
Quinsy: See Tonsils, abscess

Radium: See under names of various diseases and organs
Reflexes, labyrinth reflexes in guinea-pigs after removal of otoliths by centrifugation, 739
Respiratory Tract, effects of drugs on ciliary activity of mucosa of upper respiratory tract, *55
epidemiologic investigations of bacterial flora of upper respiratory tract with reference to postoperative angina, 748
experimental dystrophy of, 400
histologic picture of rheumatic fever; upper air and food passages in rheumatism, 395
local amyloid disease of upper air passages, report of 5 cases, *439
oxygen therapy in acute respiratory obstruction in children, *387
Reuter: Gas phlegmon as sequel to peritonsillar abscess, 749
Rheumatic Fever, histologic picture of rheumatic fever; findings in tonsils removed by operation, 395
histologic picture of rheumatic fever; upper air and food passages in rheumatism, 395
Rhinitis, new technic in surgical treatment of ozena, *370
ozena and tonsil, 520
treatment of ozena with lactic acid and acetylcholine, 107
vasomotor, clinical observations in 150 cases, 526
vasomotor; contact allergic coryza, *367
vasomotor; etiology and therapy, 525
Rhinolalia aperta, 108
Rhinoplasty: See under Nose
Rhinoscleroma at necropsy, 745
Roentgen Rays: See also under names of various diseases and organs
importance of roentgenologic examination of sinuses in chronic arthritis with reference to cases in which sinuses are a silent focus of infection, *23
new adaptation of x-ray prints and slides (demonstration), *704
Rosenwasser, H.: Rupture of suppurative cervical glands into external auditory canal, *610
Ross, P. J.: Epistaxis, 532
Three cases of microtia, 284
Rubin, H. W.: Improved operative technic for suppuration of petrous apex, *699

Salinger, S.: Hemorrhage from pharyngeal and peritonsillar abscess: report of cases; résumé of literature, and discussion of ligation of carotid artery, 128

Salivary Glands, calculi in submaxillary and sublingual glands and their ducts, *318
Sarcoma of larynx, report of 4 cases, 152
Scarlet Fever, accessory nasal sinuses in, 523
otitis media in, 102
Schüller-Christian Syndrome, difficulties of differential diagnosis, 648
Sclera, blue; case of osseous fragility with cranial deformity and blue sclerae, 399
Secretions, Internal: See Endocrine Glands
Seiferth: Labyrinth and circulatory reactions, 403
Sensation, sensory disturbances following radical operations on antrums with evaluation of vertical incision, *303
Septicemia, identity of course of posttonsillitic sepsis and puerperal sepsis, 643
tonsils in, 644
Sewall, E. C.: Decompression of facial nerve; physiology of seventh and ninth nerves and movements of lids in facial paralysis, 137
Shambaugh, G. E.: Clinical study of severe deafness in adults, 122
Shambaugh, G. E., Jr.: Clinical study of severe deafness in adults, 122
Shapiro, S. L.: Sensory disturbances following radical operations on antrums with evaluation of vertical incision, *303
Shock, experimental traumatic shock of equilibration apparatus in animals, 403
Silver, argyria nasalis; report of case, *582
Simpson, W. L.: Moving picture of external ethmosphenofrontal operation, 130
Sinuses: See also Frontal Sinus; Sphenoid Sinus
accessory nasal sinuses in scarlet fever, 523
accessory sinuses, origin of cholesteatomas of, 648
allergy of nose and paranasal sinuses, clinical analysis of 150 cases of, 153
chemical composition of sinus pus, 141
chronic diseases of paranasal sinuses and their relation to chronic laryngitis with bronchiectasis and asthma, 524
headache and pain in inflammation of nasal sinuses, 397
histopathology and clinical interpretation of experimental sinus disease, *183
importance of roentgenologic examination of sinuses in chronic arthritis with special reference to cases in which sinuses are a silent focus of infection, *23
infection in children, 396
infection of accessory sinuses in vitamin A deficiency; rôle of carotene in infection of upper respiratory tract, 396
instruments for radical operations on sinuses, *389
is "retrobulbar neuritis" as often due to disease of nasal accessory sinuses as is generally held? 741
management of chronic sinus disease, *157
pansinusitis with orbital abscess and meningitis, 530
pathogenesis and clinical picture of polysinusitis with orbital complications, 647
persistence of apparent sinus pain after multiple operations, 133, *415
radiographic study of normal sinuses in infants and children, 277
relation of exophthalmos to nasal sinus disease, 645
relation of nasal polypi to hypertrophic inflammation of nasal sinuses, 398
retrobulbar neuritis and disease of nasal accessory sinuses, 521
Skillern, S. R.: Persistence of apparent sinus pain after multiple operations, 133
Skillern, S. R., Jr.: Persistence of apparent sinus pain after multiple operations, *415
Smell, olfactory disturbances in patients with craniocerebral traumatism, 645
Smith, C. H.: Aural infections from colon bacillus; report of case, *249
Smith, F.: Management of chronic sinus disease, *157
Smyth, D. C.: Carcinoma of antrum, 282
Complete stenosis of esophagus, 284
Snyder, R. G.: Importance of roentgenologic examination of sinuses in chronic arthritis with special reference to cases in which sinuses are silent focus of infection, *23
Societies, foreign, directory of, 156, 296, 414, 536, 652, 752
national, directory of, 752
Society Transactions:
American Laryngological, Rhinological and Otological Society, 109
Chicago Larypgological and Otological Society, 406
Chicago Laryngological and Otological Society, Chicago Medical Society, Chicago Tuberculosis Society and Aux Plaines Branch, 288
German Otolaryngological Society, 401, 746
Massachusetts Eye and Ear Infirmary, Oto-Rhino-Laryngological Services, 281, 528
Sonnenschein, R.: Functional tests of hearing, *70
Sound, effect of ultra acoustic sound waves on deafened ear, 403
Specialists, certification of specialists in medicine, 638
Speculum, new nasal speculum, *618
Speech, development in deaf and dumb, 280
diagnosis of postencephalitic disturbances, 396
disorders in childhood, their nature and treatment, 279
further studies of rhinolalia aperta, 108
Sphenoid Bone, etiology of osteomyelitis of, 647
Sphenoid Sinus, moving picture of external ethmosphenofrontal operation, 130
pneumosinus; bilateral atrophy of optic nerve associated with unilateral sphenoid pneumosinus, 741
Spiess: Treatment of pulmonary tuberculosis by inhalation of serum, 749
Spinal puncture, is endolumbar irrigation with physiologic solution of sodium chloride in meningitis without danger?, 641
Stammering: See under Speech
Steinhausen: Function of cupula in ampullae of canals of labyrinth, 403
Stenger Test: See Hearing tests
Stephan, R. M.: Sensory disturbances following radical operations on antrums with evaluation of vertical incision, *303
Steuer: Development of cholesteatoma after antrotomy, 747
Stomach, partial thoracic stomach with short esophagus; 7 cases, 279
Straatsma, C. R.: Repair of postauricular fistula following radical mastoidectomy, *616
Streit operative approach to petrous tip, 405
Stroboscopy in laryngoscopy, 104
Stuttering: See under Speech
Styloid Process: See Temporal Bone
Submaxillary Gland, Calculi: See Salivary Glands, calculi
Sunde, E. A.: Infection of petrous bone; rationale of treatment and report of case, *436
Surgery, Plastic: See under Mastoid; Nose
Sweany, H. C.: Primary bronchiogenic carcinoma; incidence, pathogenesis and diagnosis, 406
Sweat and Sweat Glands; hemisudation of face in paroxysms excited by cold and appearing after endonasal operation, 646

Taylor, H. K.: Suppuration of petrosal pyramid; roentgenologic problems, 143
Teeth, injuries to teeth following operation on maxillary sinus, 648
Telephone, auditory and neurologic sequelae consecutive to action of traumatizing telephonic noises, 737
Temperature after mastoidectomy; study of 100 cases, *660
effect of temperature on nasal cilia, *607
Temporal Bone, anatomy and pathology of petrous bone based on study of 50 temporal bones, *556
certain particulars of labyrinthine reactions in 3 cases of traumatic temporal lesions, 99

Temporal Bone—Continued
functional anatomy of human temporal bone, 401
histologic structure of temporal bone of anthropoid apes, 641
improved operative technic for suppuration of petrous apex, *699
in cases of increased intracranial pressure, 642
infection of petrous bone; rationale of treatment and report of case, *436
longitudinal fracture of temporal pyramid with injury of inner ear, 748
periarteritis nodosa of, *502
pneumatization of, *172
rare malformation of petrous bone, 273
results of injection of parathormone in rats and guinea-pigs, with reference to temporal bone, 402
roentgen diagnosis of chronic diseases, 393
suppuration of petrosal pyramid: roentgenologic problems; problems concerned with anatomy, pathology and surgical therapy, 143
Theissing: Significance of hematogenous infection in tuberculosis of ear and of upper air passages with reference to experimental evidence, 746
Theobald, W. H.: New adaptation of x-ray prints and slides (demonstration), *704
Throat manifestations of blood dyscrasias, 740
septic sore throat, epidemiology of, 275
tumors of nose and throat, *621
Thrombophlebitis, etiology and pathology of paralysis of abducens nerve associated with sinus thrombophlebitis; report of case of thrombosis of lateral sinus and bilateral paralysis of abducens nerve; operation and recovery, *336
Thrombosis, cerebral (ventricular) hydrodynamic test for thrombosis of lateral sinus, *297
electrocoagulation of cavernous sinus to prevent thrombosis: report of successful case following carbuncle of nose, 149
etiology and pathology of paralysis of abducens nerve associated with sinus thrombophlebitis; report of case of thrombosis of lateral sinus and bilateral paralysis of abducens nerve, *336
labyrinthitis and sinus thrombosis complicating suppuration of middle ear, *671
limited to jugular bulb, 405
of superior vena cava, 747
pathogenesis and end-results of dural sinus thrombosis, 410
surgical importance of mastoid vein in infected lateral sinus thrombosis, 117
Thyroid, lingual thyroid gland, *594
Thyroidectomy, treatment of angina pectoris and congestive heart failure by total ablation of thyroid, importance of laryngoscopic examination as means of preventing bilateral paralysis of vocal cords, *383
Tobacco, experimental dystrophy of upper respiratory tract, 400
Tobeck: Experimental osteodystrophia fibrosa produced by overdosage of viosterol and its significance for otosclerosis, 402
Tonndorf: Operative treatment of acute infection of frontal sinuses, 749
Tonsillectomy, acne vulgaris and chronic eczema cured by, 396
Ehrlich's negative phase as contraindication, 740
end-results of tonsil and adenoid operation in childhood and adolescence, 395
ligature carrier and tier, *68
Tonsillitis, chronic, diagnosis of, 520, 644
diathermy in, 275
identity of course of posttonsillitic sepsis and puerperal sepsis, 643
roentgenotherapy, 276, 740
Tonsils, abscess; quinsy in young infant, *710
diathermy current in reconditioning of tonsils, 275
Tonsils—Continued
hematogenous infection, 103
histologic picture of rheumatic fever; findings in tonsils removed by operation, 395
immunity in inflammatory and suppurative diseases of tonsils, 749
in septicemia, 644
pathologic changes in human palatine tonsil, correlation with clinical findings, *600
ozena and tonsil, 520
Torin, D. I.: Tuberculosis of larynx, *195
Trachea, carcinoma, primary, 280
plastic closure of laryngostomic fistulas and enlargement of lumen of trachea or larynx by implantation of chondrocutaneous flap, *585
tapering tube sutured in trachea to prevent aspiration during and after laryngectomy, *69
Traeger, C.: Importance of roentgenologic examination of sinuses in chronic arthritis with special reference to cases in which sinuses are silent focus of infection, *23
Transverse sinus, arrangement of mastoid cells in relation to sigmoid portion of, *326
Tremble, G. E.: Pneumatization of temporal bone, *172
Tuberculosis, pulmonary, inhalation of serum in, 749
Tumors: See under names of organs and regions
Tympanum, rare diseases of tympanum and of middle ear, 747
so-called hydrops tympani ex vacuo, 101

Uffenorde: Thrombosis limited to jugular bulb, 405
Unterberger: Streit operative approach to petrous tip in Gradenigo symptom complex; report of case, 405
Utriculo-endolymphatic valve, function of utriculo-endolymphatic valve; 2 cases of ruptured saccules in children, *537

Van Alyea, O. E.: Irrigation in treatment of disease of frontal sinus; anatomic clinical study of nasofrontal connections, *224
Vertigo, aural, treatment by division of eighth nerve, 737
Vincent's Angina: See Angina
Vinson, P. P.: Diverticula of thoracic portion of esophagus; report of 42 cases, *508
Viosterol: See Ergosterol
Vitamin A, infection of accessory sinuses in vitamin A deficiency; rôle of carotene in infection of upper respiratory tract, 396
Vocal Cords, associated paralysis of, 644
impairment of function of musculature of vocal cords, 746
importance of laryngoscopic examination as means of preventing bilateral paralysis of vocal cords, *383
phonation with false vocal cords, dysphonia spastica and pharyngeal muscles, 104
polyp from vocal cord (microscopic slides), 281

Wachsberger, A.: New technic in surgical treatment of ozena, *370
Weber: Otosclerosis and alteration of labyrinthine capsule, 401
Weille, F. L.: Foreign body (peanut) in bronchus, 283
Osteomyelitis of frontal bone, 531
Wirth: Epidemiologic investigations of bacterial flora of upper respiratory tract with reference to postoperative angina, 748

Zange: Laryngocele in man and its operative treatment, 747
Ziegelman, E. F.: Calculi in submaxillary and sublingual glands and their ducts, *318
Surgical importance of mastoid vein in infected lateral sinus thrombosis, 117
Zona: See Herpes Zoster

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CONTENTS

PAGE

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Temperature After Mastoidectomy: A Study of One Hundred Cases. Henry P. Johnson, M.D., Portland, Me. 660

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New Adaptation of X-Ray Prints and Slides (Demonstration). Walter H. Theobald, M.D., Chicago 704

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Quinsy in a Young Infant. Harry L. Berman, M.D., New Haven, Conn. 710

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Abstracts from Current Literature 737

Society Transactions:

German Otolaryngological Society 746

Book Reviews 751

Directory of Otolaryngologic Societies 752

General Index 753